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The Easy Wrap Orthopedic Cast

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The Easy Wrap Orthopedic Cast

by

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A Thesis Submitted in Partial Fulfillment of the Requirements for
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Abstract:

The orthopedic professionals and physicians believe in a safer and faster method to replace the existing application and removal of the orthopedic cast. They also believe that the orthopedic treatment process has much more room for improvement. The Easy Wrap orthopedic cast has several benefits. First, it enhances the application and removal procedure. Second, it replaces the existing casting process to reduce the injuries to patients and physicians. Finally, it decreases the number of lawsuits against hospitals and clinics caused by cast injuries.

Background: Using a cast removal saw creates burns and cuts on patient's skin. This medical saw is also the primary cause of injuries to physicians such as HAVS (Hand-Arm Vibration Syndrome), and NIHL (Noise-Induced Hearing Loss). Thermal injuries occur when the blade of the oscillating saw produces residences force against the skin. Such injuries occur due to the imperfection of the oscillating saw and the process.

Solution: Easy Wrap Cast method is a simple solution that uses the existing material to immobilize the fractured area. EW Cast is a uniform sheet of either plaster or fiberglass in which it is applied to the broken bone to stabilize the fracture. The EW cast removal procedure is much simpler than the existing process. It does not require any power equipment to remove the cast. EW cast process is as simple as wrapping and unwrapping the cast sheets overlapping edges.

Chapter I. Introduction of the study

1-1-Proposal

Technology has improved the imperfections of medical methods and devices. However, the medical field demands further improvements. In the field of orthopedics, especially in casting, there have not been significant improvements since the 70's. An average of about 6 million people in the United States suffering from a common broken bone injury.

The majority of these broken bones cure without trouble yet, it is a lengthy process for over 300,000 cases. Some of these broken bones might not heal with conventional methods. Therefore, in many cases, surgeons and orthopedics are obligated to use orthopedic casts. The orthopedic cast itself has numerous complications, discomforts, and injuries. 72% of such injuries happen during the removal procedures. These injuries are cuts and burns due to the operation of the oscillating saw. The predominant focus of this project is to change the procedure in cast removal to eliminate the constant injuries during the process.

1-2-Problem statement

The reported cases of broken bone every year indicates that many individuals suffer from the injuries during the removal of the orthopedic cast. The removal procedure seems relatively easy, but the sensitivity of operating the oscillating saw could lead to injuries such as cuts, burns and in some cases to nerve damages. Moreover, there is the issue of a high pitch noise while removal of orthopedic cast generated by the medical saw. Younger adults, specifically children, are less patient and do not tolerate the noise. Sometimes, they are frightened of the noise that is generated by the oscillating saw. It is challenging for the medical professionals to assure children that the procedure is safe. According to Charles Mathis, a certified orthopedic technician who has been practicing over 40 years, "Cast saws can, indeed, cut skin" (Arygyle 2013). It also mentioned that the procedure is not safe and to calm down the patient a "White Lie" is given. In the 70's, professionals were obligated to be aware of the risks in using the saw. Unfortunately, today's orthopedics are under the assumption that there is no risk involved (Arygyle 2013).

1-3-Case Studies

1-3-1-Case 1:

Figure 1: Cast injuries during removal process (Arygyle 2013).

On Feb. 19th, 2013, a seven-year-old boy broke his femur. He was terrified of the removal procedure. The medical professional assured him that the cast saws are designed not to cut the skin. The boy was still nervous from the operation. During the procedure, the boy was crying and implying that “the saw is cutting” (Arygyle 2013). The tech assured him otherwise, but there were several cuts on his leg afterward (Arygyle 2013). Though the technician had 18 years of experience and to her knowledge, this incident must have been a fluke. When she switched to the other side of the cast, the same problem occurred (Arygyle 2013).

1-3-2- Case 2:

According to CBC News on Feb 21, 2017, a 2-year-old Ambriel Roulette had been burned and cut during the removal procedure of her orthopedic cast. Her mother was worried that her two-year-old might be frightened for life. After the procedure which left her arm covered in burns, the child was terrified of seeing doctors. She was suffering from two broken bones in a fall. For recovering the fracture, she went through a cast application. During the removal procedure, she was showing her emotion by exclaiming nevertheless professionals were under the assumption that she was frightened of the noise generated by the saw. After the procedure, they have noticed a burn and cut line on her arm. The doctor apologized, but her mother was worried if the toddler is scared for a lifetime (Brohman 2017).

Said by a CBC reporter "She is not only going to be terrified physically but emotionally. The poor child is going to be afraid to see a doctor."

Cast removal is a "fairly simple process," but it could end up with injuries such as burns and marks.

This process has affected child's future, and psychologically she was hurt. Two weeks passed after the procedure, yet she was afraid of strangers holding her arm (Brohman 2017).

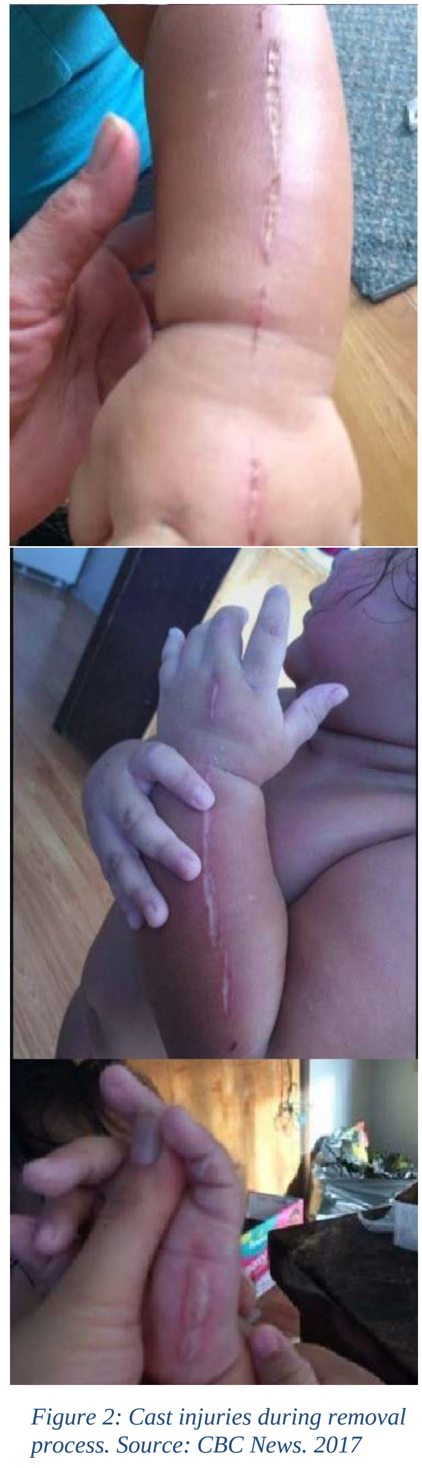


Figure 2: Cast injuries during removal process. Source: CBC News. 2017

According to studies at the Alexandra in which indicates that over a 12-month period there were 3875 cases of cast removal. Throughout these cases, almost 1% suffered from thermal and abrasion injuries. Such injuries increased the number of complaints. Patients brought in lawsuits to the hospital, demanding compensation and the primary cause of these injuries were operating cast saw
(Ansari 1998).

1-4-Thesis objective

There is a better method to remove the orthopedic cast to make the experience less traumatic specifically for children and most patients to decrease their intimidation. The thesis objective is to reduce complications and injuries to make the casting process easier. This project aims to change the process of the orthopedic cast in eliminating the use of power equipment.

Chapter II. Research Areas

2-1-Evolution of orthopedic cast

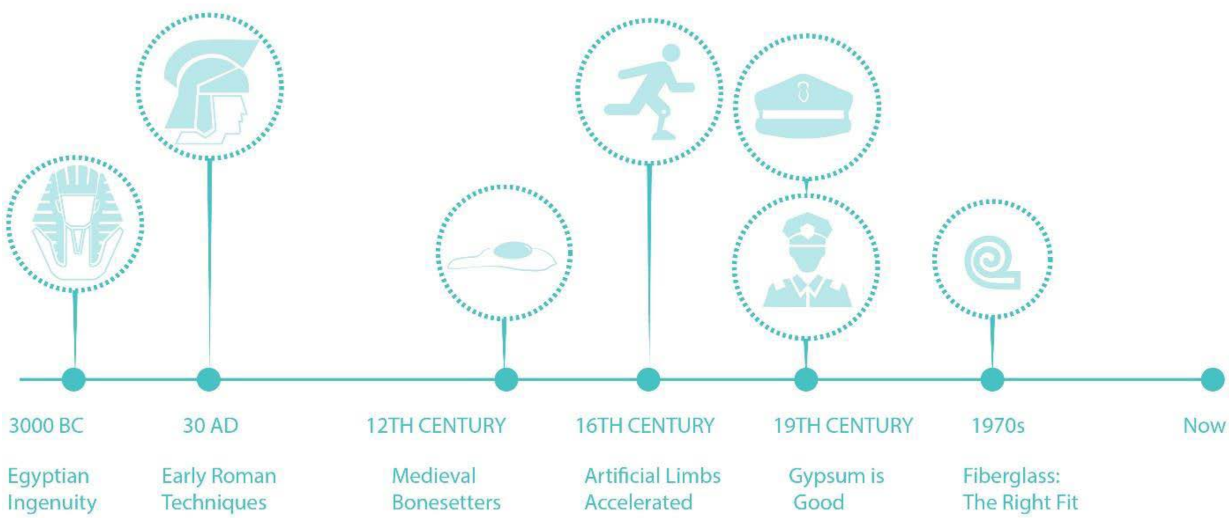


Figure 3: The evolution of orthopedic cast

Source:http://persiantebbehzad.com/images/.DownloadPDF/PDF/The%20Evolution.pdf

In the earliest known texts and discoveries that indicates the initiation of casting stems from Egyptian civilization. The first casting movement starts from a deliberate process of mummies. Egyptians preserved the body of the wealthier class instead of the disposal of the dead, in which it presumed as eternal life that demanded that their body should last for all time since they believed that the lifted spirit that had left the body would be reunited once again. Therefore, the process of mummification (ritual Purification) started amongst the kingdom which the origination of this process is unknown. In fact, this process has the similar method of casting.

Materials used in mummification variants as the ancient empires, each had different methods starting from Persia. They had used different oils or herbs which kept the body, but eventually, the body would turn black. Therefore, Egyptian civilization had a better process in place for their kingdom that could store the kings and wealthier in a better shape. The substance used in Egyptian mummification was Linen, Sawdust, Beeswax, Resin, Natron, Onion, Nile mud, Linen pads and Frankincense (Lucas 1999).

Due to the similarity in mummification, Egyptian's medical and surgical science, the orthopedic cast has been developed. This civilization used a primitive, papyrus or bark tree splint which was tightly wrapped in linens as the earliest known method of treating a broken bone.

Greek's physicians from 400 BCE, had detailed text and drawing of the proper exercise of splitting a break or fracture. In 50 CE early Roman, there was were a modification to the writings of Greek physicians by Celsius, which mentioned a technique using bandages and splints thickened with cornstarch to treat fractures. Moreover, Roman history points out to the use of waxes and resins to stiffen bandages which were similar to the process of mummification.

2-2-Cast specification

Before understanding and determination of a cast and its process, it is crucial to understand what bone is. Bone is a rigid organ that composes partial of a vertebrate skeleton. This structure protects and supports numerous organ of the human's body. It fabricates white and red blood cells, allocates support and gives structure to a human body. This organ is a substantial component, yet it is not indestructible to particular incidents. There are three main categories of the bone that can be fractured. Pathological fractures, stress fractures, and impact fractures. When part of a bone takes a hard, sudden strike, the bone absorbs more pressure than it can tolerate and that would cause an impact fracture. An excessive pressure over an extended period on the same spot of a bone would cause the stress fracture. There is another fracture that is common in elderly. This fracture is due to a disease that led to the frailty of the bone structure. The fracture is called Pathologic fracture caused by diseases such as infection, inherited bone disarray, bone cyst or cancer.

A cast is a combination of substance that immobilizes a broken bone in place as the broken bone heals. This process is to hold the bone structure and stabilize the broken bone in place in avoidance of any movement, so the body facilitates the repair of the broken bone (The connective tissue membrane covering the bone also known as periosteum) (Wikipedia 2017).

To support and cease for the bone to heal correctly, orthopedic doctors utilize casts and splints to stabilized injured bone for the period of bone mobilization. The orthopedic cast is the efficient and effective method to heal a fractured bone.

The initiation of splinting and casting demands a thorough assessment of the status of neurovascular, skin, tissues, and the structures of bone to diagnosis and assess the bone injuries. Once the physician determines the severity and the stage of the fracture, and once the necessity of the immobilization is determined, the process of cast or splint application will start.

Note: Prolonged or improper decision in choosing the application might increase the risk of complexity in immobilization.

Splint Manufacturers utilize their innovative ideas in restructuring and exploring more popular options within the splints. They provide a large variety of colors, at the same time, it is a faster application for both users and physicians. Sprains and soft tissues injuries or stable fractures treated with splints. Splints offer many advantages. The most beneficial factor is to persuade physicians to use them for injuries that are not complex at the time of application and removal. Swelling is one of the symptoms in most soft tissue injuries. Sometimes cast creates complications which are related to extra pressure on the injured portion of the body that trapped in a contained space. Therefore, splinting is the best choice for immobilization amongst acute care setting.

There are also Disadvantages in splinting which includes the limitation in usage, lack of patient compliance and excessive motion at the injury site and inappropriate for definitive care of different types of injuries which demands to cast.

2-2-1-Casting

Casting is usually for definitive or complex fractures. The orthopedic cast comes in many sizes, colors, shapes, and materials but the most two famous cast's substances are fiberglass and plaster. An orthopedic cast is a bandage that accommodates two coating. The first coat contains a soft fabric (hydrophilic inner layer) that protects the skin from the second coat which is the rigid surface (hydrophobic outer layer). Soft materials used for conventional casts includes Synthetic (stockinette), wool, foams, and cotton. The main reason for the cushion padding is to protect the skin against cast material that prevents any reaction of skin such as rashes or other allergies. Another purpose of the inner layer is for filling and thermal insulation. However, the hydrophilic inner layer such as polyester and cotton are highly absorbent and have the capability of holding water for an extended time. Furthermore, wet padding would be a great environment to grow Microorganisms such as fungi and bacteria which could cause infection, irritation, discomfort and foul odors. The mainstay of most fractures is casting. Although the cast is more efficient to immobilize the fracture, it requires more time and skill to apply and remove which could have a higher risk of complications if improperly applied (Anthony J. Campagna 2007). The second coating of casting (hydrophobic outer layer) is a rigid surface which will provide the external fixation that promotes the fracture healing. The orthopedic cast has two common materials to immobilize the fractures (Anthony J. Campagna 2007).

2-3-Different types of casts

2-3-1-Plaster of Paris

The first and very well long-established material type is known as Plaster of Paris. According to Dr. Arun Singh plaster of Paris, in its raw state, is termed gypsum hydrated calcium sulfate with impurities. The medical form is pure anhydrous calcium sulfate (Singh n.d.).

This substance does not generate any allergies, and it is incredibly safe. It is utterly adaptable to an area and other applicable components. There is no necessity to use gloves during the use of this material, and it is not complicated and quick to apply but takes a long time to cure and dry, yet it is the inexpensive material in the orthopedic cast in comparison to other materials in orthopedic field. The setting time takes many hours for the plaster of Paris. For instance, an arm cast roughly takes about thirty-six hours to dry, and a cast for leg could take up to seven days to reach its full strength. Some of the disadvantages of this material are its bulkiness, high weight and also it might become weak if it gets wet. One of the advantages of this material is the ease of formation, so physicians are more comfortable to work with the plaster. Due to the plaster of Paris method, the skin of individual’s limb is unreachable and non- washable throughout the treatment. Therefore the skin under the cast would become dry and scurfy. The cutaneous complication could be the result of this method. These complications could be listed as infection, rash, burn maceration, other allergic and discomfort. These signs may also be from the formaldehyde of the of the plaster bandages. There are other limitations to plaster cast, such as the weight of the cast that could be quite noticeable thus movement limitation, especially of a child. Removal of the cast requires destroying the plaster. Such process is fortissimo during the use of the oscillating saw. This powerful saw can cut through the hard shell, but it would be difficult to cut the cushion (soft layer). The removal of the plaster cast is commonly painless, but it can be distressing for some patient specifically children (Wikipedia 2017).

2-3-2-Fiberglass

The fiberglass tape is the modern material that physicians are using as a second coat which is similar to plaster. This medical bandage manufactures from multi-layer polymer polyurethane saturated through particular resin called fiberglass, and it is a synthetic alternative to the traditional cast such as plaster of Paris in which provides a similar effect as plaster of Paris with a difference of a lighter weight, higher durability, and less maintenance. This substance is also called a Glass Reinforced plastic (GRP) which are a polymer made of a plastic reinforced by fibers of glass. The features of this element are the capability of resisting water that makes it unique for long-term use. The unique pattern of this bandage is that there are many holes on its surface to keep a robust air ventilation. The moisture absorbed by fiberglass is eighty-five percent less than the plaster orthopedic casts. The simple operation and application of this substance make it easy for physicians to apply and also the main advantage of this component is that it takes less time to dry and it weighs less than other substances. Due to air moisture exposure to this content, acceleration of the application process by physicians is one of the requirements. Fiberglass comes in different colors and patterns that make it more fashionable. Therefore this substance is reasonably high demand (Wikipedia 2017).

2-3-2-1-Advantages and disadvantages of fiberglass

This substance of orthopedic cast is less accommodating to swelling, and it does not have a precise molding which would be great for cases that immobilization process for bone has already begun. Unlike plaster of Paris, fiberglass dries quickly. Therefore this method requires an experienced physician to initiate the process and apply the cast. Fiberglass is hygroscopic which will decrease setting time with heat and moisture. Last but not least is the differences in price. The bandage of plaster of Paris is an inexpensive substance in compare to fiberglass (Wikipedia 2017).

2-4-Application process

General Application and procedures of orthopedic (temporary or permanent) casting are quite similar. After carefully reviewing and documenting the fractures or other injuries within the soft tissue, a decision will be made to immobilize the injured bone by a physician. Therefore, a cast or splint may apply to the broken bone. Prior to application, surrounding of the injured area should be covered with protecting sheet to repel splashes of water and cast materials such as plaster or fiberglass from the patient's clothes (Wikipedia 2017).

2-4-1-Preparing the injured area

The very first and former step of the process is to sanitize the area of injured extremity to ensure it is free from dirt, oil, stains or bacteria. A stockinet or any sorts of padding is measured to the right size and applied as the first coating to cover the area where cast or splint is intended to implement. The ending sections of stockinette are folded back over to create a smooth and soft edging. The physician needs to ensure that the first layer (stockinette) is comfortable and not too dense for the patient. The second and also important step is to apply the next layer of padding over the stockinette to accommodate for swelling and to prevent the skin from maceration. This padding is applied peripherally around the injured area in which one end of the padding will cover the underlayer by over 40% which will automatically provide two layers of padding. The areas that bones elevate extra padding is necessary to avoid any irritations or discomforts. The padding should not be overused; otherwise poor fit of cast or splint and potential complication could take place. Ultimately the last layer should be applied in which different substance might have different application process (Wikipedia 2017).

2-4-1-1-Splinting

The splint material should immerse with water, and while the substance is bubbling, it submerges in water. After soaking the splint, the physician should remove it from water, and the excess water should be extracted yet the substance needs to stay damp. Then splint is placed over the injured extremity and should be kneaded by the palm simultaneously to avoid any overpressure produced by fingers. Ultimately the edging of the padding and stockinette is folded over the splint to provide a smooth and comfortable end. At last of the process, the dried splint is sealed with bandage warped or Velcro to secure the splint (Wikipedia 2017).

2-4-1-2-Casting

The process of casting is very similar to splinting. After preparation and measuring the stockinette and padding the physician prepare the patient fracture to cast. The ending sections of stockinette are folded back over to create a comfortable and soft edging, then the fiberglass or plaster will be applied. The bandage of plaster or fiberglass is swathe circumferentially and skin to the padding each roll of wrapping is overlaying each other to produce a thicker cast. To ensure that the orthopedic cast is not constrictive and tight the placing of excess on the plaster or fiberglass should be avoided. Ignoring this fact could cause complications such as neurovascular compromise, or the excessive pressure could damage underlying skin. Unlike the splinting process before applying the final layer of the cast the padding and stockinette should fold back to provide the extra soft edging then the last layer can be applied. Molding of the cast is the most critical factor in this process. While the material is still malleable, the physician should use a consistent pressure throughout the entire cast to stabilize, so the cast could effectively help the immobilization process (Wikipedia 2017).

2-4-2-Application process illustration

Figure 4: Application Process

Source: Smith, Gail. 2011. YouTube. Accessed 05 13, 2016. https://www.youtube.com/watch?v=OipZa7zZ2Vc.

2-5 Types of fractures

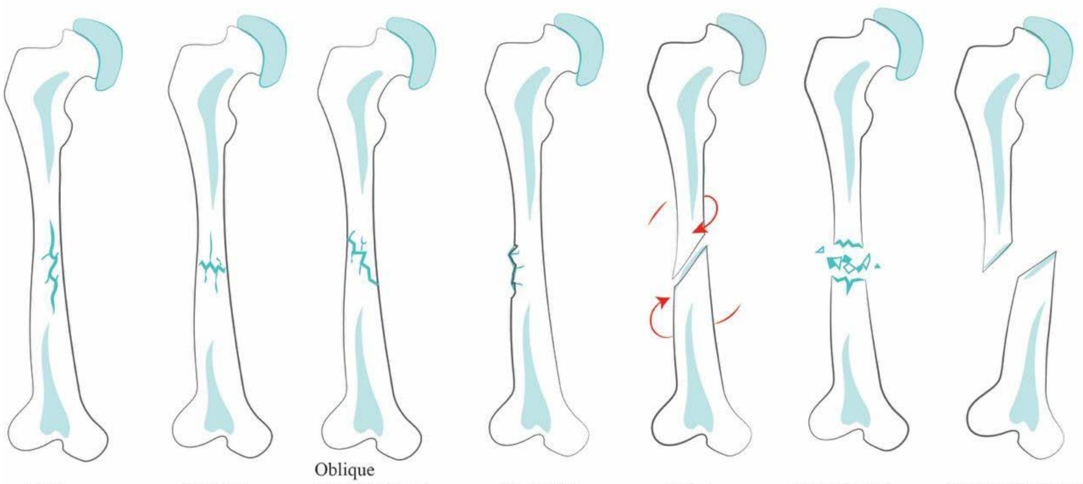


Figure 5: Types of fractures

As an individual senescence, the bone mineral density (BMD) becomes harder and brittle. All types of the bone fractures can occur. Among all kinds of bone fractures, the Greenstick fracture is the most common fracture in children and teenagers due to the flexibility of their bones. (The Arizona Science Center 2011).

2-6-Five common broken bones in human body

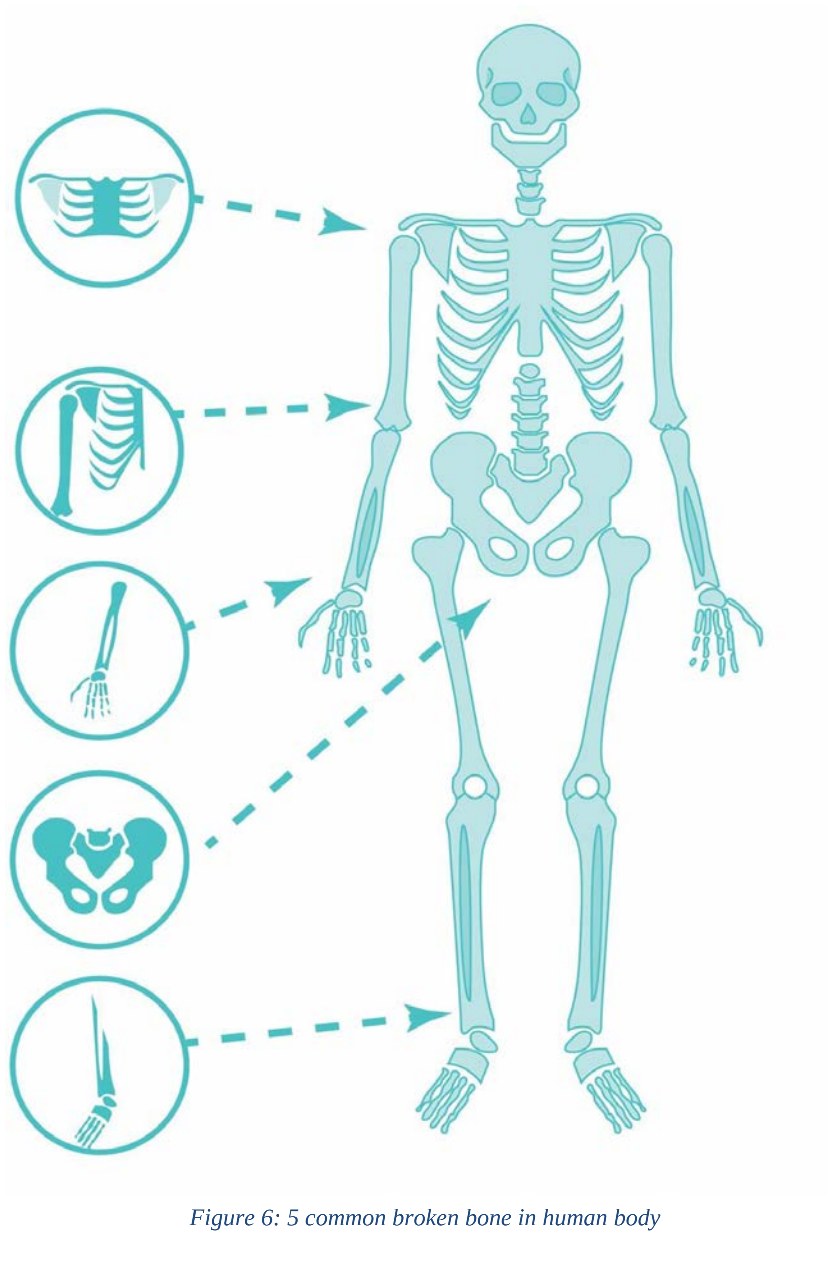


Figure 6: 5 common broken bone in human body

Clavicle: In human Anatomy Collarbone or the medical term of the clavicle in the upper part of the human body in between of the shoulders connect the trunk of the human body to arms. The only horizontal long bone found in the human body is the collarbone which are two, one on the right and one on the left side of the human body. The clavicle is the number one common bone that fractures (Singh n.d.).

Arm: The appendage or are which is the upper limb of human anatomy that extends from the shoulder joint and the end of the hand. The most common broken bone is Humerus in the upper arm (Singh n.d.).

Wrist: The wrist bones provide the human body more flexibility and support. There are eight bones that form the wrist. The most common broken bone are Ulna and Radius inhuman wrist

(Singh n.d.).

Hip: Pelvic bone or commonly known as the hip is a large flat bone, located in the center of the human body and spreads below and above. The fractures of this bone are most common amongst the ages of sixty-five and older. Women within this period have a higher rate of hip fracture due to low calcium (osteoporosis) (Singh n.d.).

Ankle: The Talocrural or ankle is the part of human anatomy where the leg and foot meet. Anything from twisting the ankle while playing or taking a wrong step when hiking can cause a fracture (Singh n.d.).

2-7-The different types of cast:

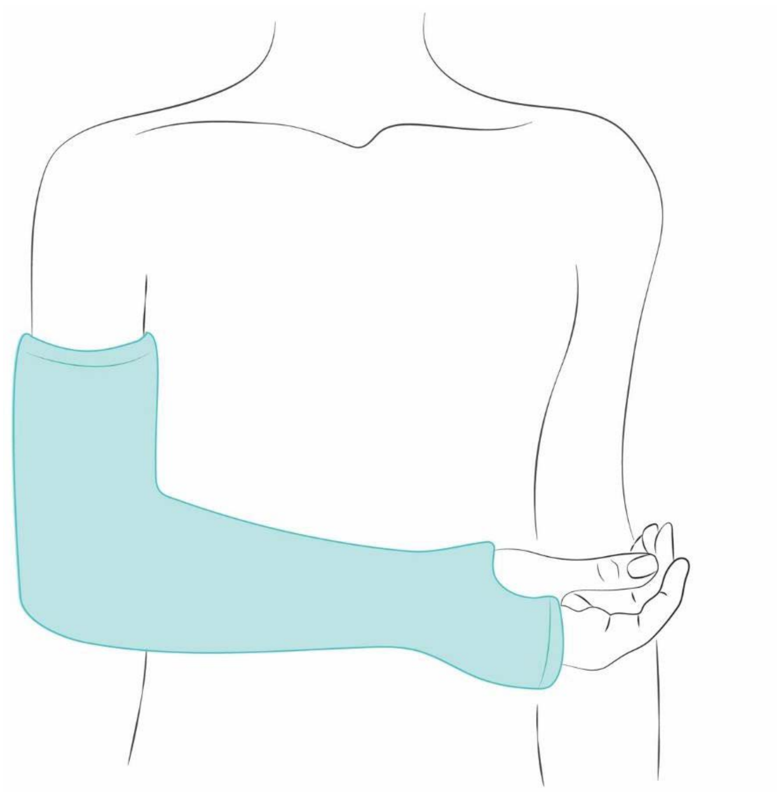


Figure 7: Upper arm cast

Long arm cast: An orthopedic cast used to immobilize proximal elbow forearm or skeletally injuries from upper arm to the hand. This cast is treating the fractures in elbow, Humerus, Forearm and non-buckle wrist fractures. This cast is to increase immobilization of forearm and greater stability. Another use of this cast is for holding the muscles in elbow and arm after surgery. All radius/ulna fractures (except isolated distal radius fracture), distal humerus/humeral, olecranon/epicondyle fracture (Mansbridge 2014).

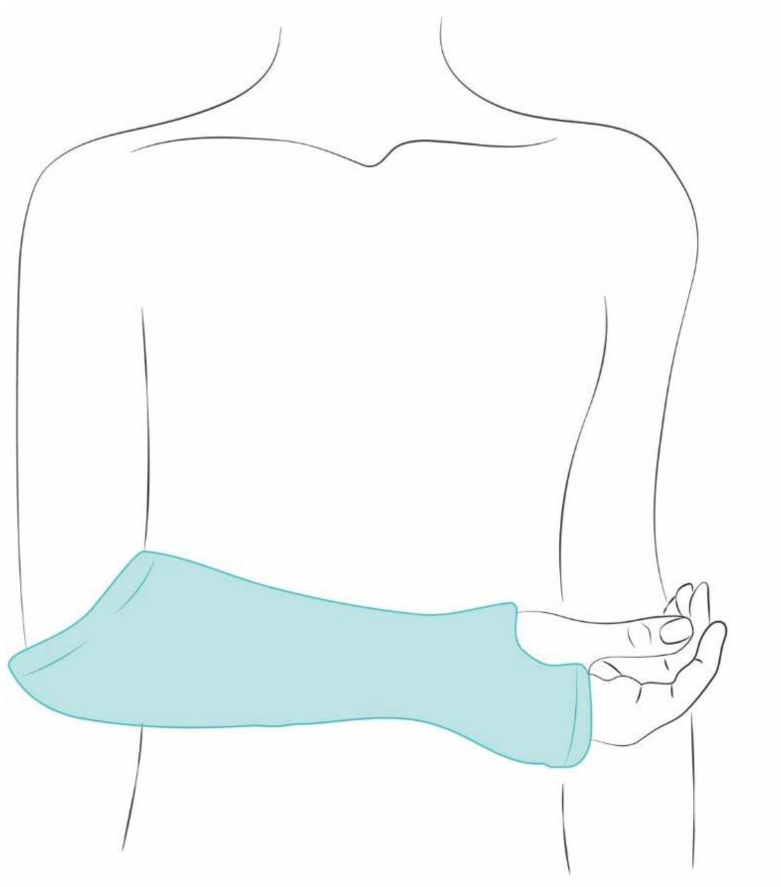


Figure 8: Short arm cast

Short arm cast: This cast is for immobilizing, stabilize positioning and maintaining the healing process of a non-angulated hand and wrist fractures or soft tissue injuries to hand and wrist (Singh n.d.). Such cast is to apply below the elbow to the wrist or hand. **Position:** Extends from ~5cm below the olecranon to just proximal to the knuckles on the dorsum of the hand. The distal crease on the palmar aspect wrist usually is neutral but can be flexed and ulnar deviated (Colles cast variation for Colles' fracture) or extended (for smith's fractures) (Mansbridge 2014).

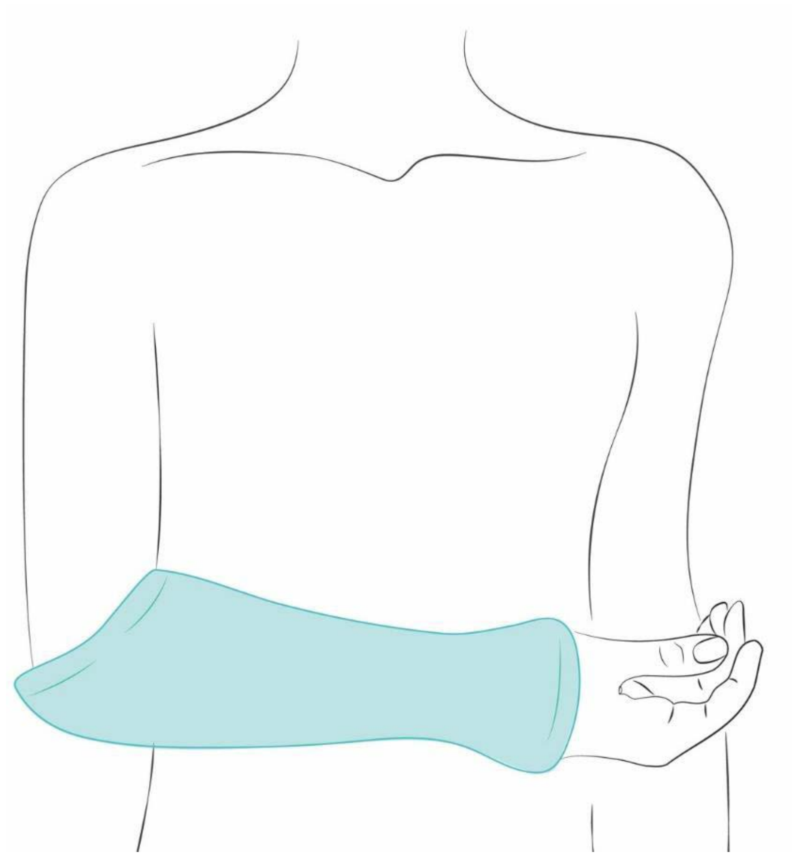


Figure 9: Arm cylinder cast

Arm cylinder cast: Arm cylinder cast is a cast that includes elbow and the lower arm to upper arm, but no cast on the hand, wrist, and shoulder. This cast is used to immobilize the fracture in elbow or to hold the tendons and muscles in place after surgery or dislocation (Singh n.d.).

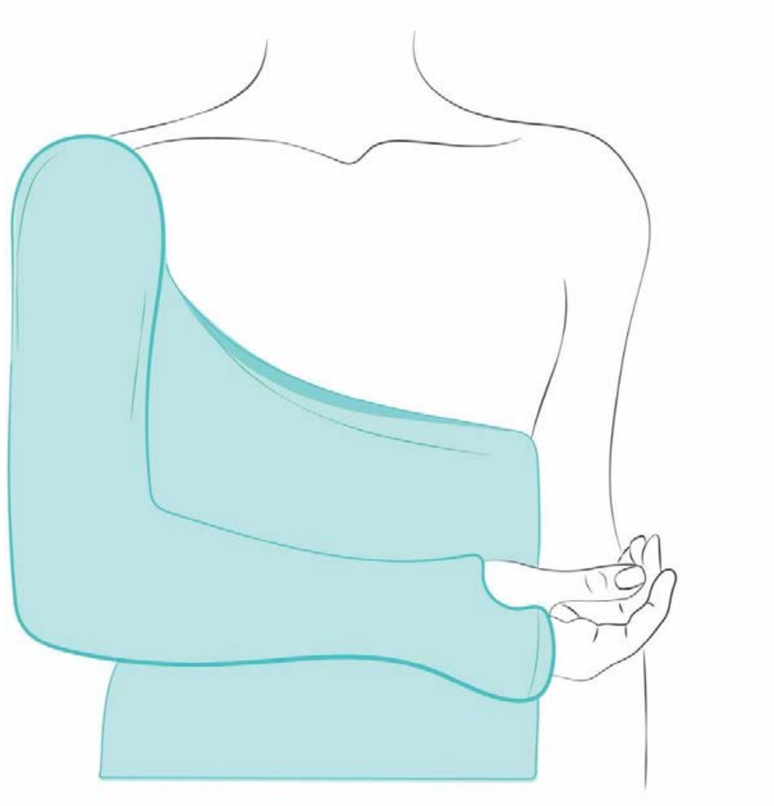


Figure 10: Shoulder spica cast

Shoulder Spica Cast: This cast is to treat shoulder injuries dislocations, stabilizing, immobilization and positioning the shoulder after surgery. This cast is wrapped around the trunk of the body to the arms and shoulders and sometimes hands (Singh n.d.).

Minerva Cast: Minerva jacket cast is an orthopedic cast that applies to the head and trunk with holes cut out of ears and face. The section around the trunk is extended to the thickened ventral plate on each segment of the body to the distal ribs section and across the border of the rib posteriorly. This cast is used to immobilize part of the trunk and head in treating of thoracic, torticollis and cervical injuries or infections (Singh n.d.).

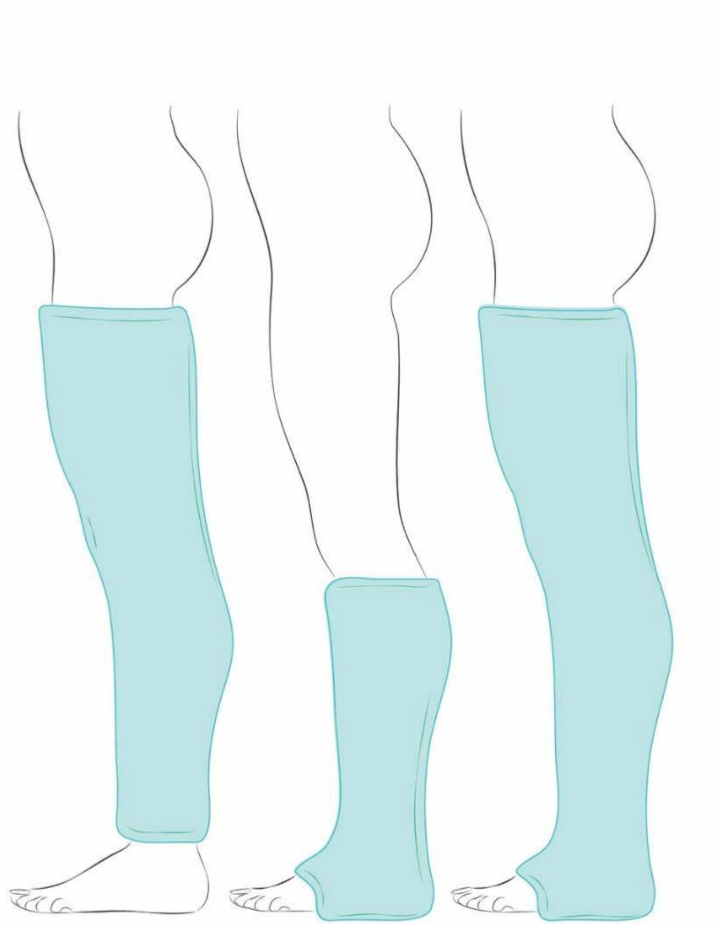


Figure 11:Leg cylinder cast/Short leg cast/Long leg cast

Short leg cast: Calcaneus/talus fracture, Fibula fracture, Ankle fracture. This cast is used to immobilize base toe, below knee fractures/dislocations, also is commonly used for torn ankle ligaments and severe sprains. The region of application of this cast on human body usually is from ankle to upper high (Singh n.d.).

Long Cylinder Cast: Ankle fracture, Fibula fracture, Distal humerus/patella fracture. The cast starts from over the knee and extends to ankle (Singh n.d.).

Long Leg Cast: Distal humerus/ patella fracture, Tibia and fibula fracture. This cast starts from the bottom of hip to the base of the toes. Knee in 5-20-degree flexion, Ankle neutral, Cylinder cast variation which ends before ankles (Singh n.d.).

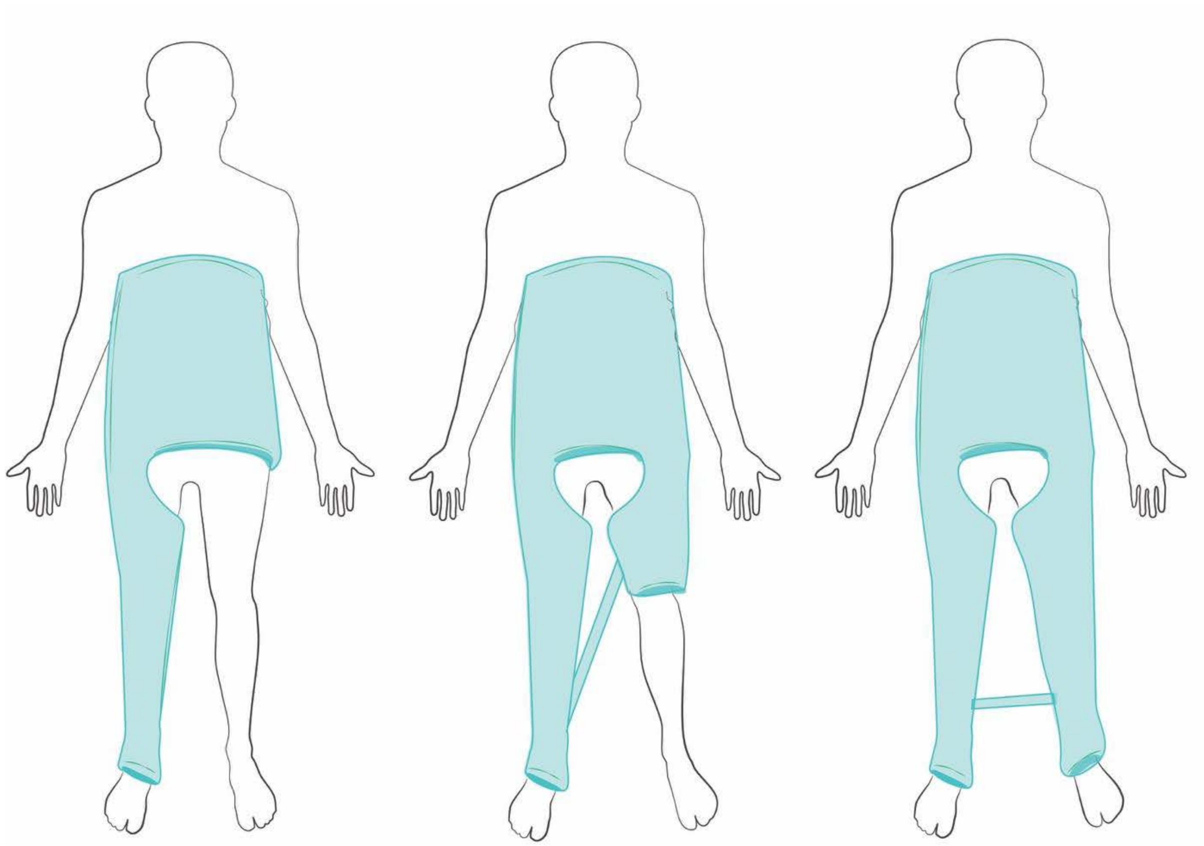


Figure 12: Unilateral hip spica cast/One and one-half/Bilateral long leg hip Spica cast

Unilateral hip Spica cast: This cast is to facilitate in treating hip joint injuries or fractures. This cast applies to the trunk of the body to the foot on one leg (Singh n.d.).

One and one-half hip Spica cast: This plaster cast is very similar to unilateral hip Spica cast with the difference of wrapping the plaster around the trunk to the knee of one leg and the foot of the other. This cast is commonly usable in tight fractures, and also it is to hold thigh or hip muscles in place after surgery (Singh n.d.).

Bilateral long leg hip Spica cast: Bilateral long leg hip Spica cast is excellent for thigh, hip or pelvis fractures and just like other Spica cast it can be used to hold thigh and hip tendons and muscles after surgery. This cast gets applied similarly to one, and one-half hip Spica cast with a difference of having the plaster on both legs to keep both legs immobilized (Singh n.d.).

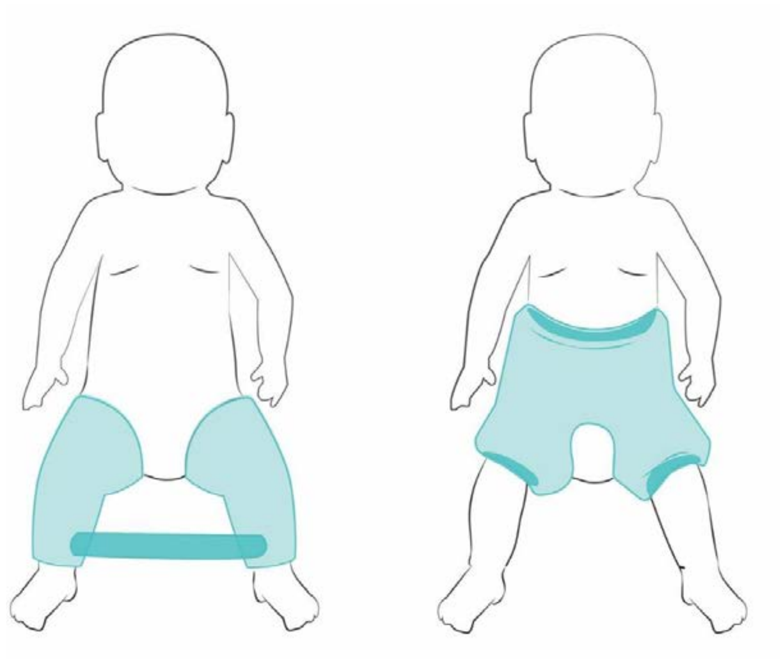


Figure 13:: Abduction boot cast/Short leg hip spica cast

Short leg hip Spica cast: An orthopedic cast is to hold tendons and hip muscles in place after surgery to properly heal. The cast wraps around the trunk of the body to the knees or thighs (Singh n.d.).

Abduction boot cast: This orthopedic cast is to apply on the upper thighs to the feet. A rod is placed between both legs to immobilize the hip. Such orthopedic cast has the same effect as Short leg hip Spica cast which holds the hip muscles in place to immobilize after surgery (Singh n.d.).

2-8-Removal of a cast

Removal of a cast is a process that involves risks of injuries to patients. This procedure is always a tedious task for both patient and surgeon. Therefore, the method demands a qualified physician or medical personnel.

The equipment that is necessary for removing a cast is supportive bandages or appliances, materials for washing limbs, benders, scissors, electric cutters or oscillating saw. Specific unpadded and tight orthopedic casts get cut with plaster shears. On the other hand a complete padded plaster cast shears open with an oscillating saw or an electric cutter (Singh n.d.).

2-8-1-Plaster cast removal complications

There are several aspects of a removal process that the operator should keep in mind. The most important factor is the noise of the oscillating saw or an electric cutter that intimidates kids. Therefore shears could be used. The patient should have the comprehension of the procedure and the tools that physician is using to operate shall be demonstrated to make the patient feel at ease. This method should be performed in a calm atmosphere to progress steadily and smoothly. The physician should converse with the patient during the operation of removal and assure that the procedure is safe so that the patient’s attention diverts (Singh n.d.).

2-8-2-Removal of plaster cast

The dimension of shears that is used to start the removal of the cast depends on the size of the plaster. The cutting guidelines drawing on the orthopedic cast shall be printed and away from bony prominences. The shear will notch the padding/stockinette edging, so the position of the cutting tool is above the material appropriately. The cutting tool (oscillating saw) should be placed on the guidelines to start the process. If the blade is aligned incorrectly, it might press into the flesh causing burns, laceration or even bruises. Subsequently, the alignment of the blade with the guideline prior the second cut is crucial. This step is mandatory because the tip of the blade could press uncomfortably on the skin. The cutter does not have the capability of cutting the round edges. Therefore the blade should follow the straight or semi bent guideline. Using the cutting tool could bring complications if the patient is not still. If the patient moves, the force of the blade cast will not be consistent. Therefore the physician or the medical personnel performing the procedure might not be able to control the cutting tool. This maneuvering might injure the patient or sometimes the performer. This cutting tool is suitable for a completely padded orthopedic cast. When operating the oscillating saw or the electric cutter, no strain should be on the cable/line, and the cable must have the right length for the operation. The cutter has the capability of cutting any material. Therefore keeping the wire away from the blade is critical. (Singh n.d.).

As an example, a leg cast removal will start from the outer side at the top, and the physician should proceed to cut the cast from the back of the calf. The oscillating saw should be moved to cut along the outer edge of the foot and the second gash on the orthopedic cast must be on the side of the leg at the top. The third cut should be on the inside of the ankle. The final cut is on the inside of the foot at the toes. At last, using a cast spreader tool, the cast should be separated so the physician can remove it. The stockinet and the padding or any bandages are separable with medical scissors (Singh n.d.).

2-8-3-Removal of orthopedic cast illustration

1. Scoring The Cut line On Cast

2. Using An Oscillating Saw To Cut The Cast Through The Line

3. Repeat the procedure So The Cast Is Cut Throughly

Figure 14: Removal process

Source: https://myria.com/cast-removal-step-by-step-photos

4. Remove The Padding Using Medical Scissors.

5. Cutting Stockinette With Scissors.

Figure 15: Removal process

Source: https://myria.com/cast-removal-step-by-step-photos

2-9-Problem definition

2-9-1-Local cast complication

Allergic reaction of the patient to cast fiber material which is absorbed more with newer synthetic cast material is one of the complications (Singh n.d.).
Skin trauma is an altering physical injury throughout the skin which may happen if the limb moves while the cast is drying, an elevation forms in the cast generating a pressure point on the underlying skin. The physician's finger might create this pressure point in casting process (Singh n.d.).
Compression of the veins by the cast could produce a moderate constriction, stopping the blood circulation, discomfort, pain, swelling and a blue color under the nails or skin which eventually might lead to neurovascular compromise (Singh n.d.).
A non-palpable pulse, pale and cold skin indicates that the blood circulation (arterial supply) is disrupted and needs immediate medical attention which is a serious cast complication. Arterial disruption may lead to surgery and splitting cast may not relieve the arterial compression.
Plaster sores are the most frequent complication within the cast procedures which indicates a poor application. This complication may cause sleep disruption and temperature elevation. There are five grades of a cast sore: **Grade I** is when redness on skin has appeared. **Grade II** involves a tissue or cellulitis subcutaneous. **Grade III** is the involvement of the muscle tissue, and the fifth grade is bone deep. The treatment process for the cast sore depends on what stage/grade it is where the first grade only requires the removal of the pressure, and other degrees may need different treatment such as surgery (Singh n.d.).
Position loss is another common complication in the plaster casting application. Most fractures

follow with swelling. The physician applies padding under the cast to protect the skin. The compression of this padding may lead to a loose cast. Therefore, the orthopedic casting might not immobilize the bone, and it may position against undesirable muscle action. This displacement may cause a gradual or sudden pain, and it might delay the healing process or lead to deformity in the bone (Singh n.d.).

Nerve damage is when a cast is applied too tight and this complication followed by tingling, numbness, loss of power and finally impaired nerve function (Singh n.d.).

Softening and breaking the plaster occur due to many reasons such as wet cast, persistent pressure on a specific area like the heel or foot, improper care of the cast and attempts to repair the cast by patients. This complication could only be fixed by replacing the orthopedic cast (Singh n.d.).

To avoid the above complication facts and precautions need to be followed. This procedure needs to be operated by experienced and skilled physicians. (Singh n.d.).

(Singh n.d.).

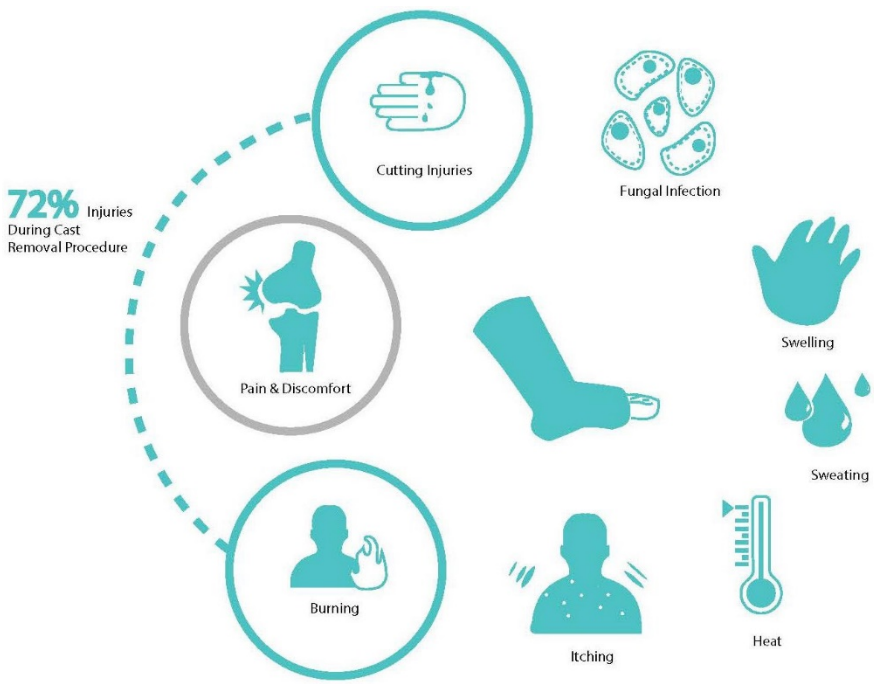


Figure 16: Complications of the orthopedic cast

2-9-2-Oscillating saw:

Figure 17:Oscillating saw

Source: http://www.bsnmedical.com/en/products/orthopaedics/categ ory-product-search-o/fracture-management/cast-removal/delta-castr- saw.html

In 1947 a tool was developed by Dr. Homer Stryker who was an orthopedic surgeon. This tool was the existing oscillating saw in which helps techs and doctors to remove the fiberglass and plaster cast. This machine was invented to improve the procedure of cast removal and reduce the injuries for both patients and practitioners. The blade on the saw moves back and forth in high speed so it can cut through the hard cast eliminating in cutting the patient (Cluett 2017). This machine has small and sharp teethed blade, and when it is against a hard surface of the cast it will cut through the material but since it is vibrating, the skin moves back and forth, and theoretically, it should not cut through the skin. Therefore, it would not be as dangerous as a circular saw. Although this invention reduces the risks of injuries yet abrasions and burns may occur from the heat created by frictional forces of the blade and its direct contact with the skin. Many patients especially toddlers are freighted from cast saws due to noises that are generated by the cast. Also, the cast saw itself creates a lot of pollutions and splashing particles. The saw injuries might be abrasive or thermal or both. The factor risk of thermal consists of using a dull blade, concavity cutting, padding in which are thin, and at last a thin casting material. Abrasive risk factors could be thin pads, sharp blades and bony prominences (M. A. Halanski 2016).

The injuries occurred with the oscillating saw varies with different aspects. Such injuries can lead to considerable legal suits. According to reports the abrasive or thermal injuries caused by the saw are in an average of $445,144 or $15,898/patient in one year period (M. A. Halanski 2016).

Thermal injuries occur when blade temperature increases during the procedure go more than 40.5°C. The record indicates that in some cases temperature was up to 110°C (M. A. Halanski 2016).

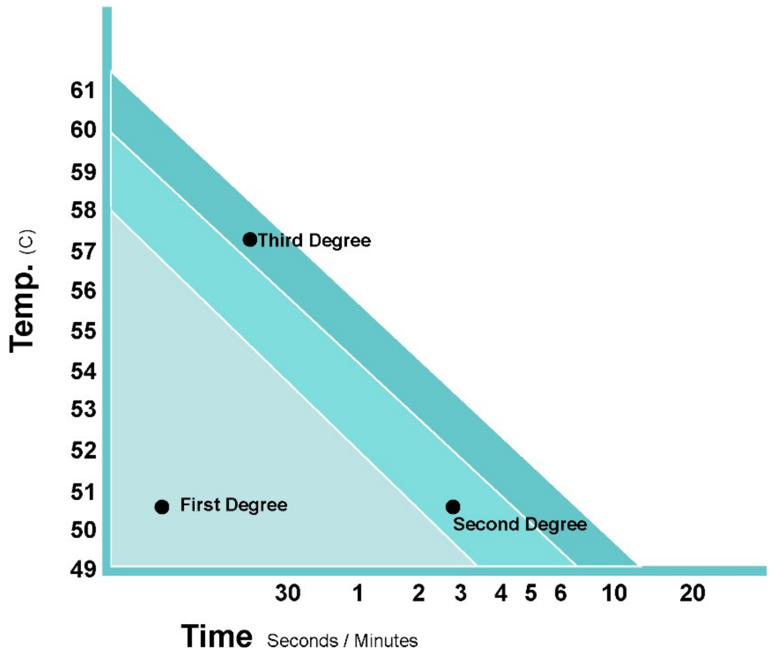


Figure 18: Thermal injuries degrees (M. A. Halanski 2016)

2-9-2-1-Risk factors for thermal injury

On the other hand, the cases of abrasive injuries were triple the cases of thermal injuries. Such injuries occur when there are too much of force on the blade where the skin has immobilized and had no room to skip therefore cuts appear on the skin (Figure 19) (M. A. Halanski 2016)

Cast materials could also increase the risk of thermal injuries during the procedure of removal. Fiberglass cast will generate more friction during the removal then the plaster removal. The cast more than 0.5 inches have been reported to have a temperature of 210°F and keeping the thickness of the cast less than 3/8 inches would be safer (M. A. Halanski 2016). The cast padding should be four layers or less to avoid thermal injuries (M. A. Halanski 2016).

Figure 19:Abrasion of the blade

Source: Halanski, Matthew A. 2016. "How to Avoid Cast Saw Complications." Journal of Pediatric Orthopaedics 36: S1-S5.

2-9-2-2-Risk factors for abrasive injury

The sharpness of a blade could increase the risk of cuts and abrasive injuries (M. A. Halanski 2016). These sharp teeth can cut through hard materials and if the teeth are pressed too hard on the skin, it will immobilize the skin and will cut the skin. Also, softer material will increase the risk of abrasive injuries. If a cast is soft or harder than the right strength, it could lead to an abrasive injury (M. A. Halanski 2016). For instance, of the cast is too hard more force is a necessity to cut the cast and more force could lead to a cut. On the other hand, if a cast is too soft (if insufficient time is given for an orthopedic cast to set or if it is wet) also could lead to abrasive injuries (M. A. Halanski 2016). There was a study that performed the cast saw to identify the injuries caused by the oscillating saw. According to Dr. Monroe's study; "Of the 18 study participants, 16 touched the model surface with the cast saw; 7 of the 18 participants maintained blade contact with the skin for > 1 second 22 times during the testing process. Participants with less experience averaged 20 (± 16) touches, whereas more experienced participants averaged 24 (± 19) touches (P = 0.7). An average number of touches was similar-before 22 (± 20) and after 25 (± 22); P = 0.5-participants completed an education module. There was no correlation between experience and participation in the education program with a decreased number of blade-to-skin touches. Nearly all clinicians inadvertently contacted the underlying skin with the cast-saw blade. In our limited sample size, experience and education did not prevent this; therefore, minimizing the time of contact and blade temperature may be more important factors in minimizing cast-saw injuries.” (Monroe 2014).

2-9-2-3-Human factor injuries

Human factors contribute a crucial role in the operation of cast removal. Patient and the technician both can increase the risk of the cast saw injuries. The patient who is less communicative such as nonverbal patient and toddlers could have the most injuries due to a lack of addressing the technician during a painful procedure (M. A. Halanski 2016). The medical profession does not take all patients who are complaining of pain under consideration during the cast procedures, and that leads to injuries. Another factor that could cause burns and cuts are the poor user technics operating cast saws (Halanski 2016). Most of the injuries caused by improper removal are thermal injuries due to the friction of the blade and temperature. If the blade gets too close to skin by pushing down the saw cuts appears on patient’s skin (Halanski 2016).

2-9-2-What are the risks to the orthopedic from using the saw

2-9-2-1-Risk from vibrating

According to research observed by Dr. S Robert, Mr. G Ashcroft, “The vibration transmitted to the hand and upper limb by prolonged operation of vibrating tools such as orthopedic saws can result in the disease known as **Hand-Arm Vibration Syndrome (HAVS)** in which individuals may complain of white finger, numbness or muscle and joint problems.” Dr. Ashcroft’s research shows potential nerve abnormalities and musculoskeletal of **HAVS 2** and neurological symptoms for operators (Orthopedic Products News 2008).

2-9-2-2-Risks from noise exposure

Both patients and medical professionals are under the exposure of noise pollution by using the saw. Due to this fact, there is a possibility of hearing loss risk affected by prolonged exposure to this contamination specifically for older patients (Nott 2003). According to National Institute of Occupational Safety and Health, the saw generates a noise between 76.5 decibels (dB) (Marsh 2011). The level above 85 (dB) is considered as harmful (Marsh 2011). Although the noise level in orthopedic cast clinics is within safe limits, the exposure to the noise more than eight hours could lead to a hearing injuries (Orthopedic Products News 2008). Over 50% of clinicians and physicians with an exposure to the noise at a more extended time repeatedly show the symptoms of NIHL (Love 2003).

Figure 20: Oscillating saw vacuum

Source: http://www.bsnmedical.com/en/products/orthopaedics/category-product-search-o/fracture-management/cast-removal/delta-castr- saw.html

2-10-Technology Research

2-10-1- New inventions

Casterpillar cast cutter

The design of 'CASTERPILLAR' Cast Cutter is for improving the safety and comfort of both patient and professionals, but this tool is not suitable for cutting more than two layers cast. Unlike oscillating saw, this equipment does not generate a loud noise, and its advantage is that children are not frightened by this tool. The tool works like sheers. Therefore there is no vibration, yet the sufficiency of the saw will not meet for casts with more debt. (Ross Wark Medical Ltd 2014).

Figure 21: Casterpillar cast cutter

Source: https://www.rosswark.com

Quiet cast saw

A unique equipment in which specially designed for toddlers to have the pleasant experience. This tool made the procedure more comfortable for orthopedic professionals during a cast removal of children. The equipment is similar to a can opener. Caregivers start from the tip of the cast and run it through the cast. The disadvantages of this tool are the time that it consumes to open an orthopedic cast, the life of the battery is not sufficed to open all casts, and the last problem is its weakness in opening complex casts (OrthoPediatrics 2010).

Figure 22: Quiet cast saw

Source: http://www.opnews.com/2008/10/power-tools-in-orthopaedic-surgery-an-update/4718.

Chapter III. Analysis

3-1-Current situation and observations survey

According to the overall observations and interviews with individuals that had orthopedic cast, their main complaints represented of how nuisance and stressful it was for patients even though the doctors and professions assure them about the safety of the procedure. They also complained about the extreme vibrations that the removal procedure caused. Moreover, According to Dr. Posnick (Orthopedic surgeon), this method for doctors and professionals is very stressful. He also noted of the debris and particles that the saw produces during the removal although the saw has its vacuum system, yet it still is not safe for both patients and doctors to be that environments.

It is also important to mention as stated by Dr. Halanski "Blade sharpness is a good example of the cast- saw area. The sharper the blade, the lower the blade temperature, the lower the risk of thermal injury; however, the sharper the blade, the higher the risk of abrasive injury. This is also the case with cast padding. The more padding, the less risk of cast-saw injury, but this may lead to more lost reductions, which is the reason the cast is on in the first place".

3-1-1-Lawsuit

The anxiety and stress caused by the removal of cast procedure are not only for the patients but also it is very traumatic for doctors and medical professionals. It is hard and laborious to be sure that the process is cautiously taking place until the cast is fully opened. According to Medscape Malpractice report in 2015, 4000 primary care physicians and specialists participated in a survey to determine why most doctors go through the lawsuit. Each year numbers of orthopedics get affected by the lawsuit, and the suit changes the future of their career and their care decisions for their patients. Obviously, the consequences of the lawsuit change the financial and emotional aspects of orthopedics, and in some cases, this matter leads to loss of license of doctors and professionals. According to figure 23, 79% of orthopedists had lawsuit. This number shows that followed by gynecologists and surgeons this number is at its pinnacle amongst all other medical fields (Peckman 2015).

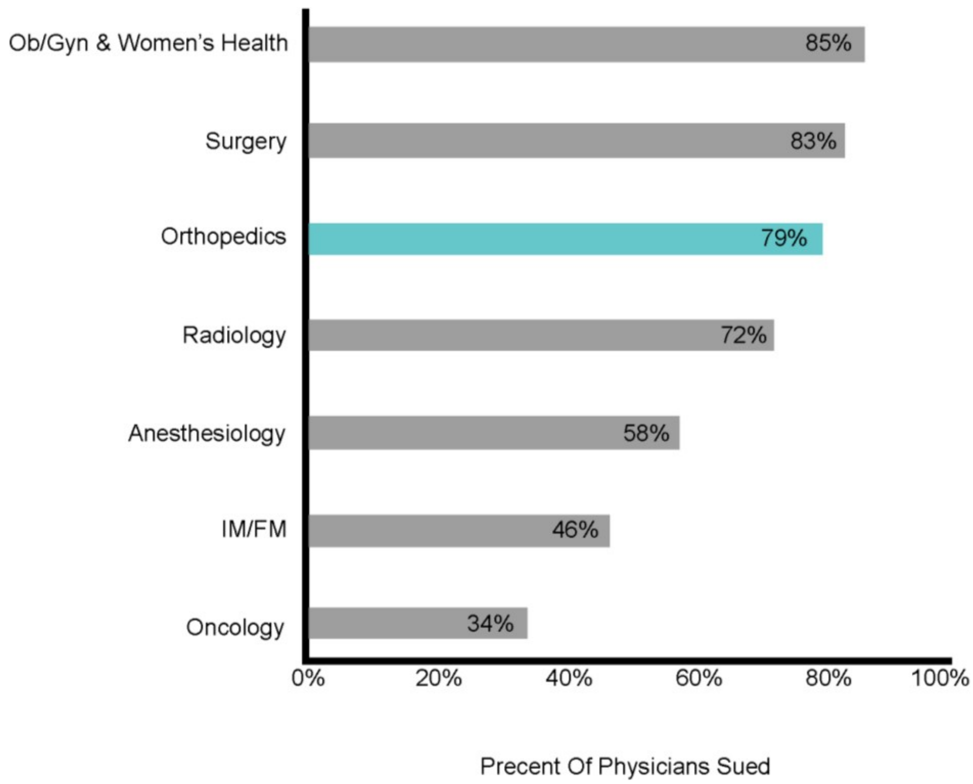


Figure 23: Physician lawsuit survey (Peckman 2015)

According to figure 24, Patients who suffered from abnormal injuries and others affected by a failure to follow the safety procedures by physicians are the two main factors that led to injuries while using cast saw (Peckman 2015). These injuries which conclude 31% of abnormal injuries and 3% are avoidance of following the safety procedures are subject to lawsuits, and that leads to the jeopardy of clinician's future career. Other factors are also subject to increase injuries, and trials such as failure to treat at 12%, inability to diagnoses 31% and others are minor

(Peckman 2015).

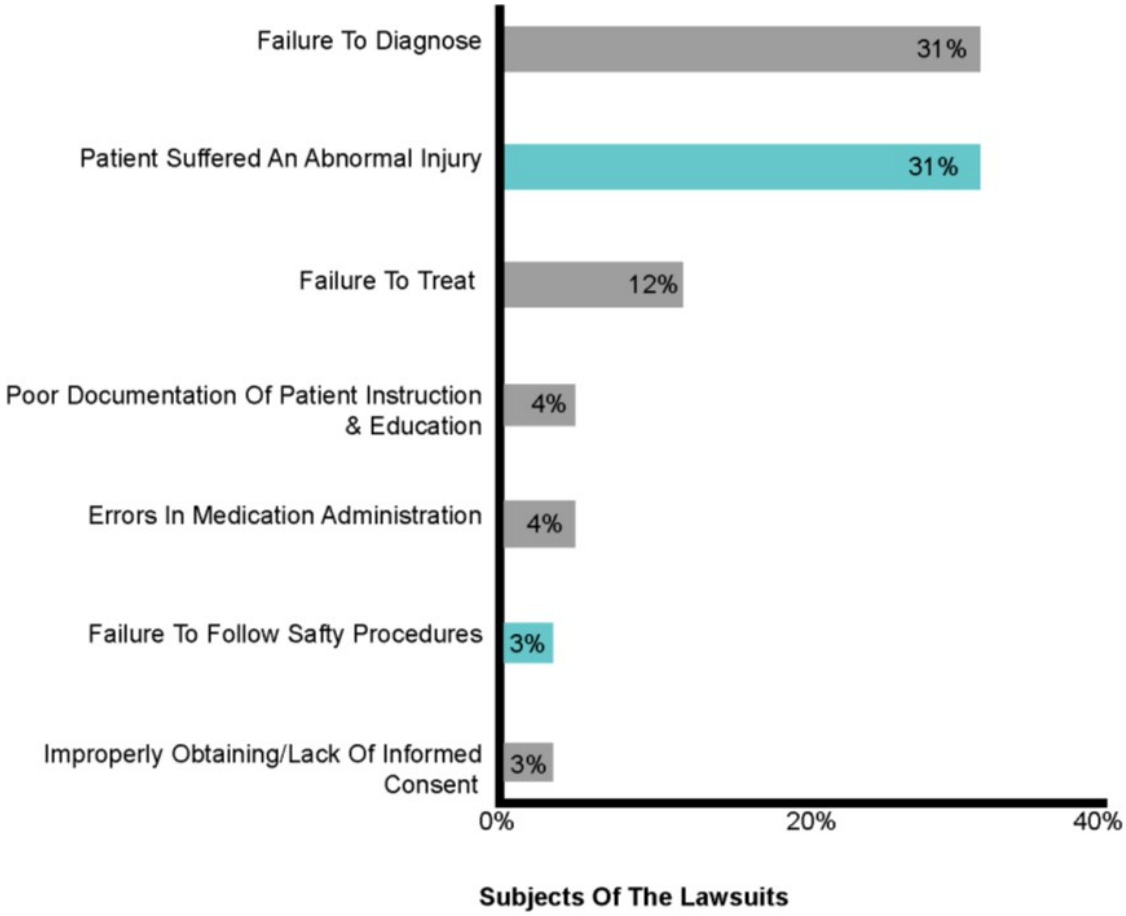


Figure 24: Subject of the lawsuit (Peckman 2015)

3-2-Target user

According to National Ambulatory Medical Care Survey & American Academy of Orthopedic, most common issues are fractured bones. Each year over 6.8 million case absorbs the attention of medicals in the United States. Every individual experience two fractures throughout their lifetime. The overall age of individuals suffering from a fracture is from the newborn to adults of 60+ as shown in figure 25.

Figure 25: Age range of broken bone Data

Source: National Ambulatory Medical Care Survey & American Academy of Orthopaedic

- Each year approximately 3.5 million visits the emergency department with a fracture.
- The wrist fracture is common before the age of 75 and after this age hip fracture is a common broken bone.
- Home is where almost 40% of fracture occurs, and the other happens outside specifically for children, athletes, and laborers.

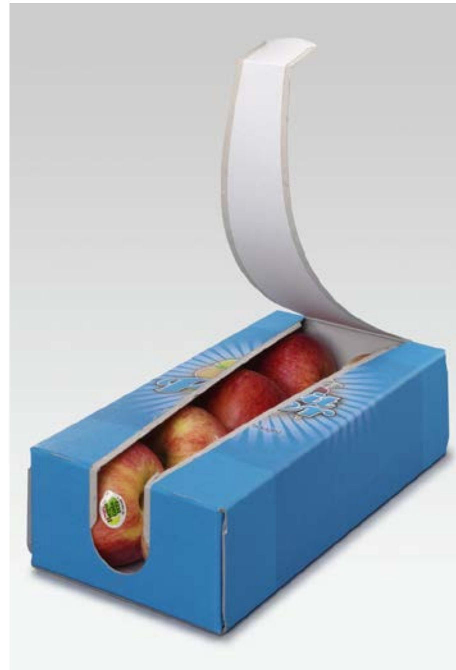
- An annual rate of 2.8 per 100 fractures are amongst men, and 2.0 per 100 are women.
- Around 890,000 are hospitalized as a result of fracture each year, and about 329,000 are hip fractures, 102,000 ankle fractures and 68,000 are tibia and fibula fractures.

Chapter IV. Design process

4-1-Directions

According to the evidence and data observed, the attention was towards enhancing orthopedic cast, covering five common fractures to eliminate injuries during the removal procedure. Technology has evaluated and improved the existing materials and equipment in medical field, yet the orthopedic field is still in need of modification. However, there are new tools that were recently designed, but since they are new and do not have much of a lifecycle in the market clinicians and doctors would rather use the conventional method. They would rather avoid the complication and of learning and the use of new tools. The traditional process follows lawsuits for almost half of the physicians. Therefore, the goal was to change the existing method without changing the material of application. This research and innovation are aiming to accelerate the process of application, reduce lawsuits for physicians, and eliminate the problems during removal procedures.

4-1-1-Refined direction (why?)



Since the invention of the oscillating saw to this date, more studies took place to improve the process of cast removal in eliminating injuries for individuals exposed to the procedure, yet many complications occurred. The simple solutions are always the best. Such solutions are especially rewarding when the problem familiarized, but the problem continues to happen. Trying to identify a single point in the process to avert the problem and exploit it, especially if it is simple and low cost, seems to be the ideal solution.

The inspiration for this project is by absorbing the packaging industry. Every package offers a unique and simple solution to be unchallenging for users to open regardless of their age and ability (BSI n.d.).

Despite the simple solution and the ease of opening on packages, they are secure and safe for children or individuals whom the content of the package could be a threat to their life.

This project aims to follow the same concept in package industry to provide a unique idea for physicians to ease the opening procedure of the orthopedic cast and avoid individual in opening the cast simultaneously.

Figure 26: Examples of easy open packages

Source: https://www.bakeryandsnacks.com/Article/2013/10/14/Payne-and-Contego-Healthcare-changes-name-to-Essentra-Packaging

4-2-Design development

4-2-1-Ideation 1

Built-In sharp metal string

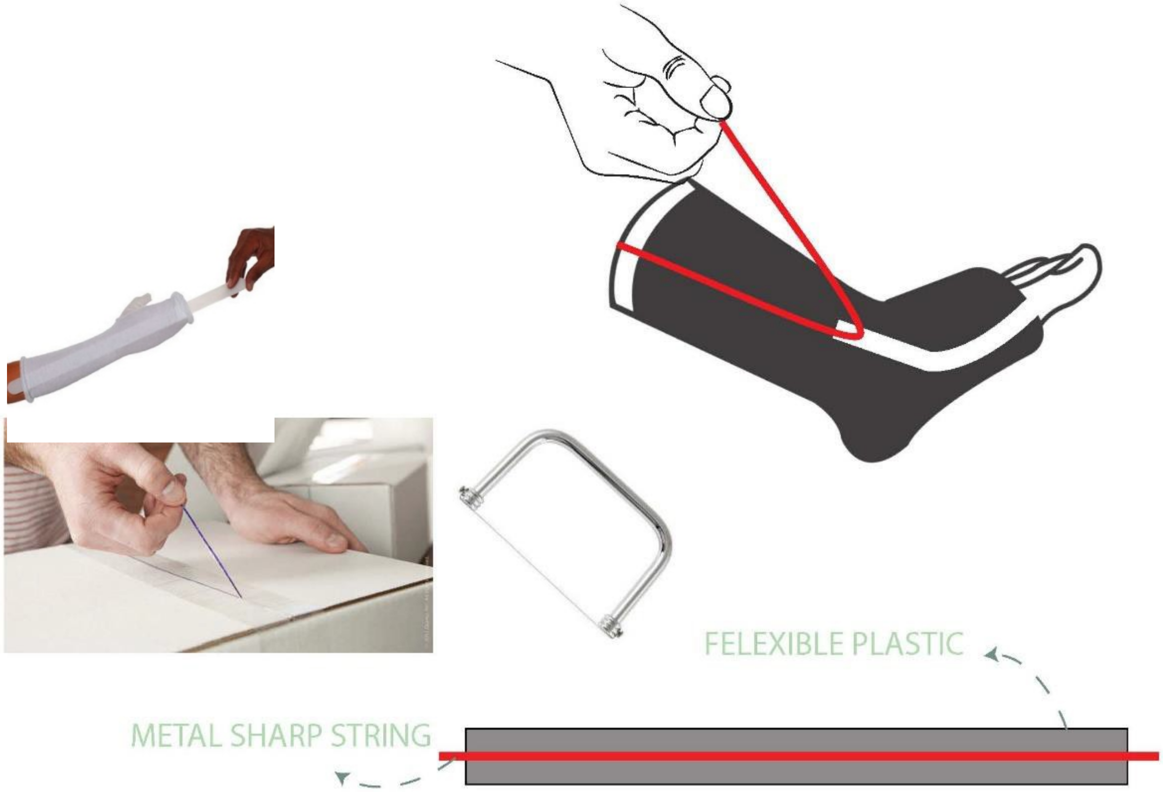


Figure 27: Built in metal string
Source: http://www.unpressablebuttons.com/2012/07/easy-open-packing-tape-concept.html
https://www.performancehealth.com/catalog/product/view/_ignore_category/1/id/26596/s/zip-stick-19-cutting-strip-1/

This idea is merging the coping saw and easy open packaging tape concept.

This ideation is a relatively easy process for medical professionals. This ideation mounts the coping saw blade into a plastic liner (Zip Cutting Strip Cast Removal Aid) which the physician can place it beneath the cast. Similar to a regular cast application process, the physician immobilizes individual’s fractured body part. Throughout the removal, process physician locates the trigger of the zip and with an angle tool (a tool that is similar to a medical plier) dismounts the zip. This process will cut the cast, and the physician can remove the cast with no injuries.

4-2-2-Ideation 2

Tracing the cut line on the cast

Figure 28: Perforated cast

The second idea is perforating a series of cut lines (dots) on the cast (often small and close together) to allow the two sides to separate after the process of immobilization. This design can make the removal process a safe procedure for both clinicians and patients.

4-2-3-Ideation 3

Built-In Plastic Strips

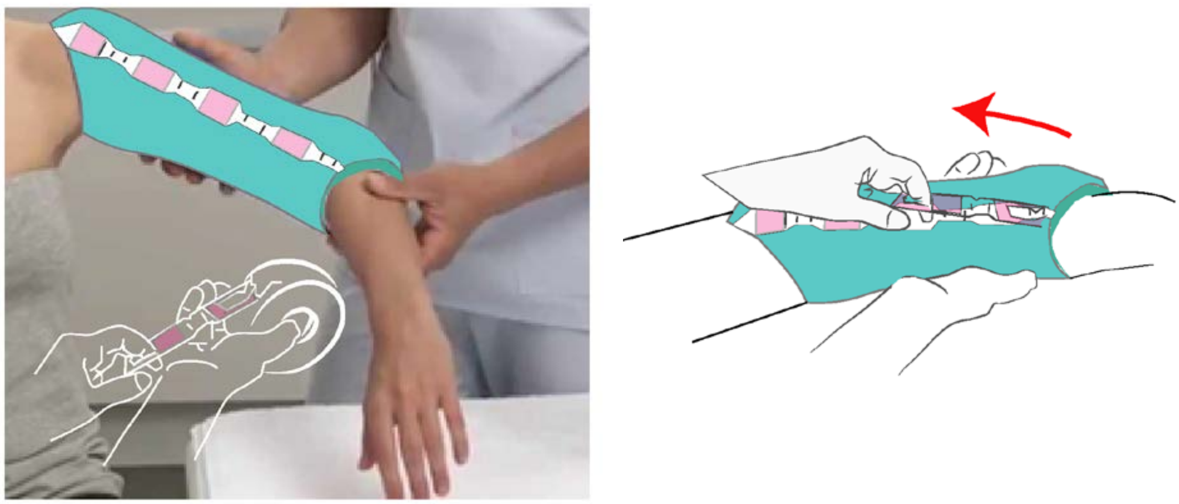


Figure 29: Plastic strip

The third ideation is a process in which the physician places a strip as shown in figure 29, on the cut line of the cast. The strip remains throughout the immobilization process. The removal procedure starts with situating the patient in cast room locating the strip of the cutline and then pull the strip out of the cutline. This action will separate the cutline and dismount the cast from the patient's (Arm or leg). This procedure can successfully remove the cast unaccompanied by a power tool. Such procedure will eliminate the thermal or abrasive injuries and will be safe for both patients and clinicians.

4-3-Experimentation of the three ideas

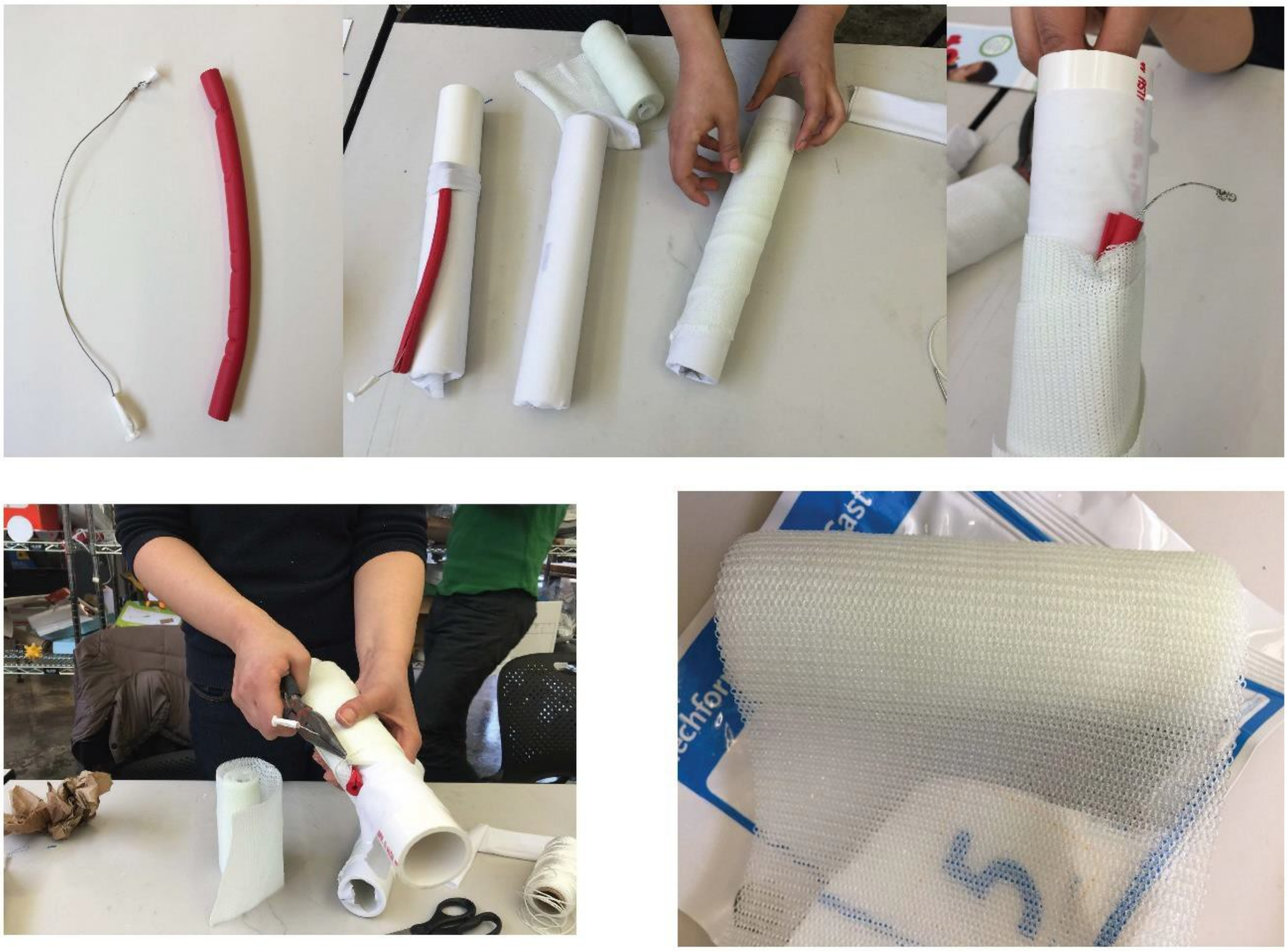


Figure 30: Experimentation process of idea 1

This is the experiment of my first ideation using fiberglass orthopedic casting tape. A 3" PVC tube performed as a human arm model. Step one is the application of fabric to function as a stockinette. Before rolling the cast tape, a sharp metal string was positioned. Then the fiberglass tape was applied as shown in the figure30. After the fiberglass tape is thoroughly dried, an attempt was made to pull the string to tear the cast. Since the line was sharp, a pair of pliers was utilized to remove the wire.

Figure 31: Experimentation process of strength

Result: Partial of the cast has been cut. Due to the rapid setting and limitation of fiberglass tape, the time was not sufficient to experiment. Therefore further experiments involved plaster of Paris. It was discovered, aside from the sharp metal string, a dominant force was also required to perform this procedure. To conclude, this ideation was not fast and suitable for orthopedic physicians nor met the expectations.

Figure 32: Experimentation process of idea 2

The second ideation is perforating the cast. The cut lines by perforation can lower the strength of the cut line. The aperture traces on the cast was created by punctuating wholes through the cast.

Result: Thickness of the cast was a challenge for the traces to dismount and separate the cast. Similar to the first ideation, with the existence of the perforation there were complications in pulling the punctuated part of the cast.

Figure 33: Experimentation process of idea 3

Ideation three is the foundation of the final idea. After the application of stockinette, the plastic strip was mounted over. Subsequently, the cast was applied. After the cast is thoroughly dried, an attempt was made to pull the strip to tear the cast. Since the cast was thick, it required more force to tear cast, and that led to splitting the strip.

It was discovered that, rolling the cast was the main complication. On the one hand, it thickened the cast causing difficulties tearing the cast.

The transformation of the rolled cast to sheet cast was discovered at this stage.

Figure 34: Ripped the strip during removal process

EW
ORTHOPEDIC
CAST

4-4-Final idea

4-4-1-Easy wrap orthopedic cast

The ideation of Easy Wrap Orthopedic Cast is to change the application and removal procedure of casting utilizing the existing materials. The other perspective of switching to this cast is to eliminate using a power tool in the removal process. EW cast comes as one sheet of plaster/fiberglass in a sealed package. Dimension on the cast sheets is simplified as three small, medium and large perforated sizes in which it can be adjusted according to the fracture types and sizes of fractured area. The cast has specific thickness according to different fracture types. The EW cast's depth starts from a ¼ inch to 1 inch thick depending on the area of the fracture. These prefabricated plaster or fiberglass sheets are inexpensive and available in settings so it can cover three common fractures area such as the arm, wrist, and leg.

4-4-1-1-Application process:

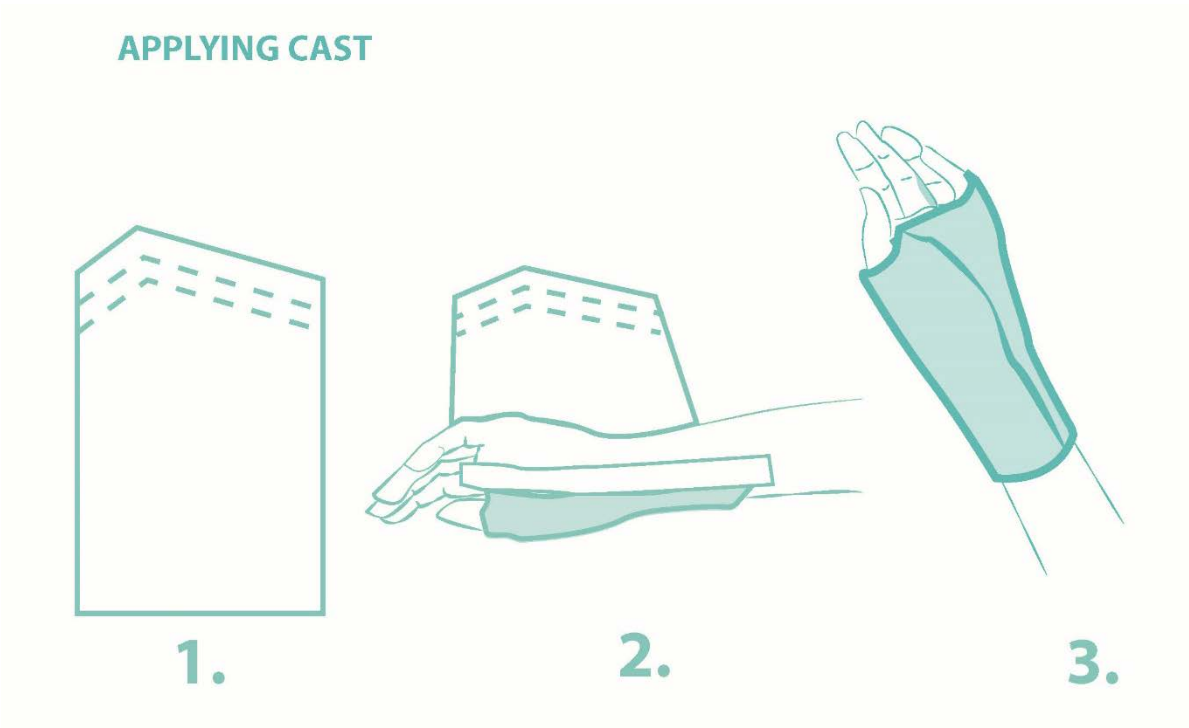


Figure 35: Easy wrap orthopedic cast application process

Preparation for estimating the length of (EW) plaster or fiberglass material needed, the physician should lay the sheet next to the area being treated. Ultimately, the fractured area should have multiple layers, padding, and stockinette. Unlike the traditional cast, EW cast does not come in a role, and the physicians receive the cast as sheets. This process starts with using the stockinette, layers of padding and then after soaking the sheet in water to activate the cast, the physician can place one side of the EW cast sheet and the EW strip over the edge. This process follows by wrapping the cast over the fractured bone and overlapping the other edge of the cast on the EW strip.

4-4-1-2-Removal process:

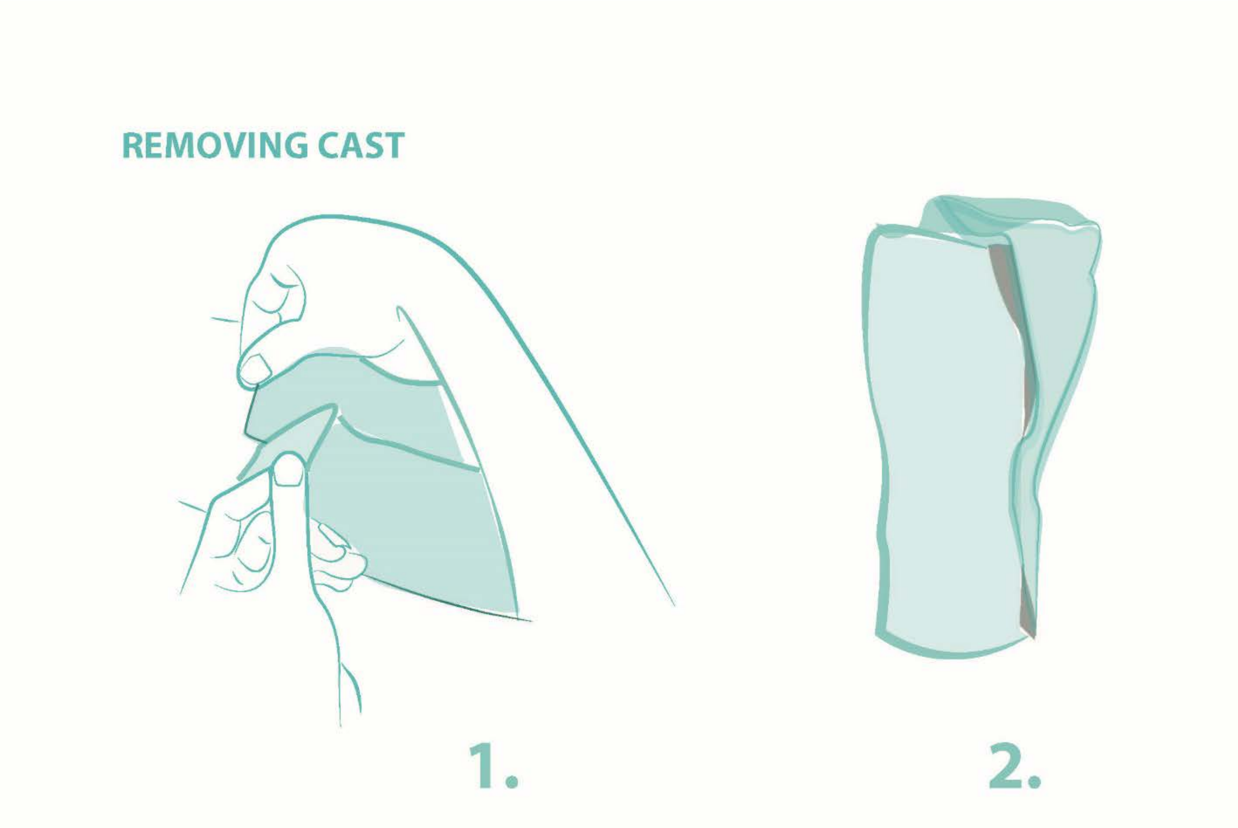


Figure 36: Easy wrap orthopedic cast removal process:

Once the immobilization period is over, the patient is instructed to attend and visit the clinician to start the removal process. The removal process is two simple steps. After preparing the patient, the physician releases the secured lock to reach the edge of the cast and merely reach the EW strip. By pulling the strip, the edge of the cast separates to be open.

4-5-Material specification

4-5-1-EW Cast

The materials of EW cast are relatively similar to the existing cast applications. The EW cast consists of mesh sheet of EW plaster/fiberglass. The sheet adheres with seven layers of plaster or fiberglass and extra fibers to higher the strength of the sheet.

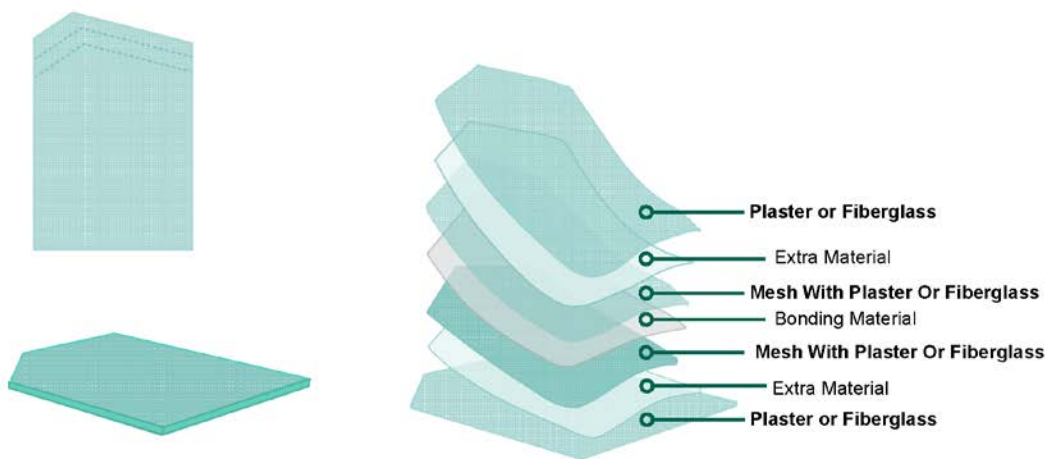


Figure 37: Material specification of easy wrap orthopedic cast

4-5-2-The EW cast strip

The EW Cast Strip is a thermosetting polymer (water resistance foam) which is the piece dividing the edges of the cast sheet that makes the removal process more manageable. The strip is mounted in between two edges of the cast sheets and avoids the adherence of the two edges. When the cast immobilization process is over, the physician can simply remove the strip to break the cast and remove it from the fractured area.

4-6- Further improvement

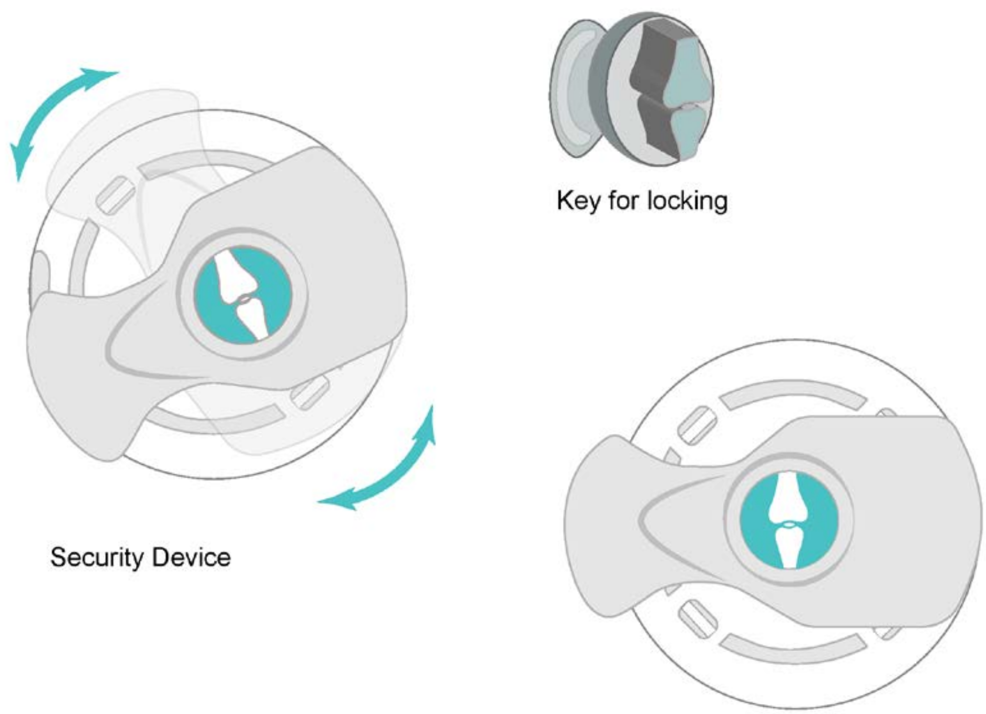


Figure 38: Easy wrap orthopedic cast security lock

The EW Security compartment of the cast is very similar to anti-theft security devices in stores. This compartment loops over the cured EW cast to assure that the patient cannot tamper with the cast (open the cast). The physician can determine the quantity of the security compartments needed for different fractured areas.

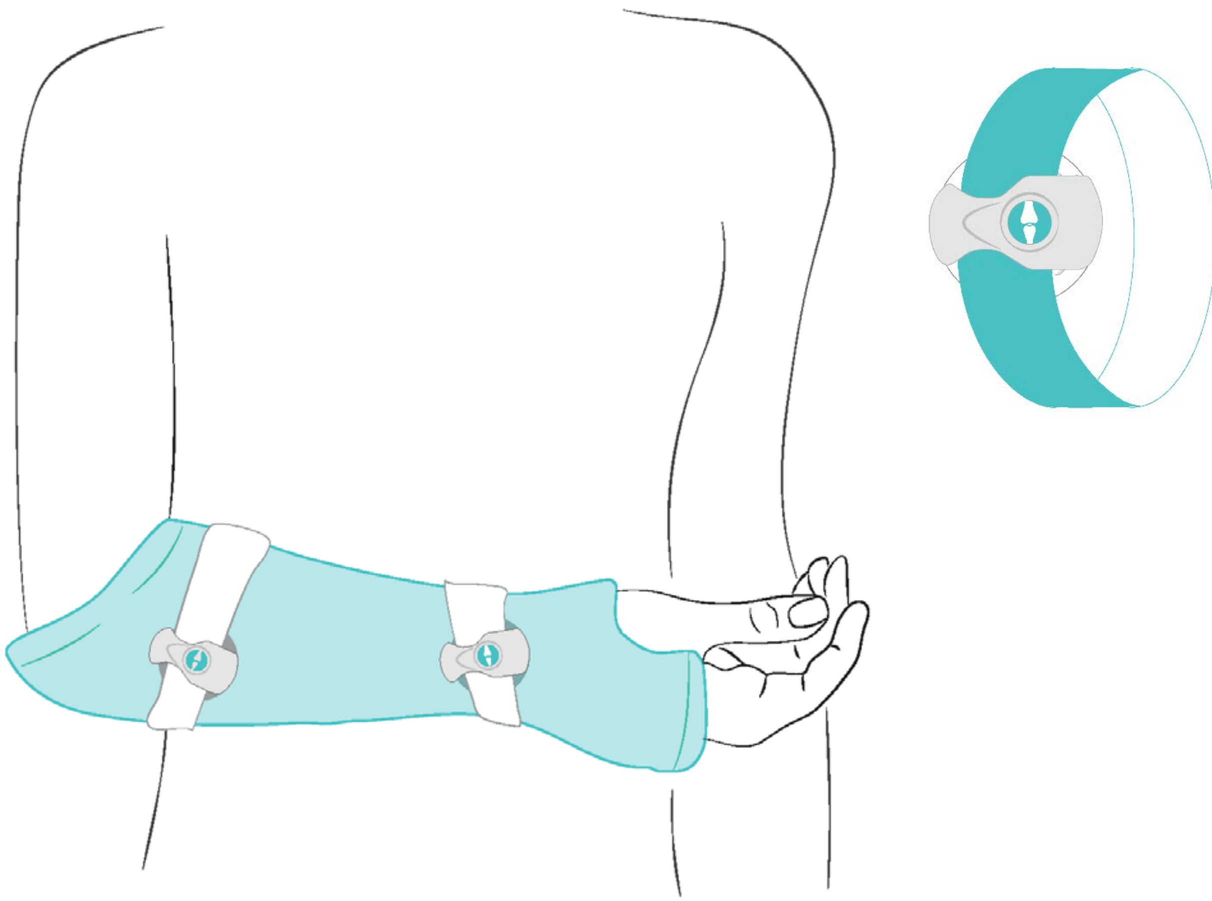


Figure 39: Easy wrap orthopedic cast security illustration

4-7-Advantages of EW orthopedic cast

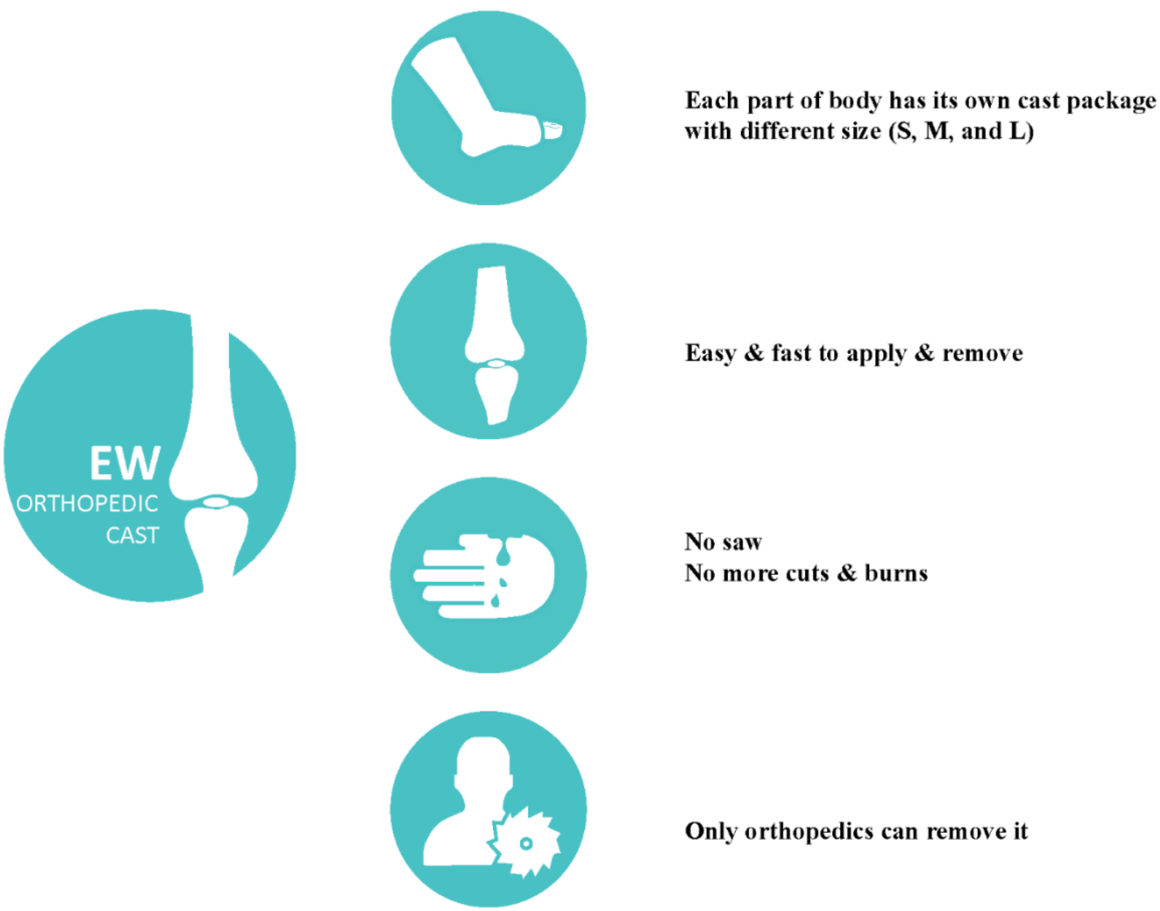


Figure 40: Advantages of EW orthopedic cast

4-7-1-The coverage of EW orthopedic cast

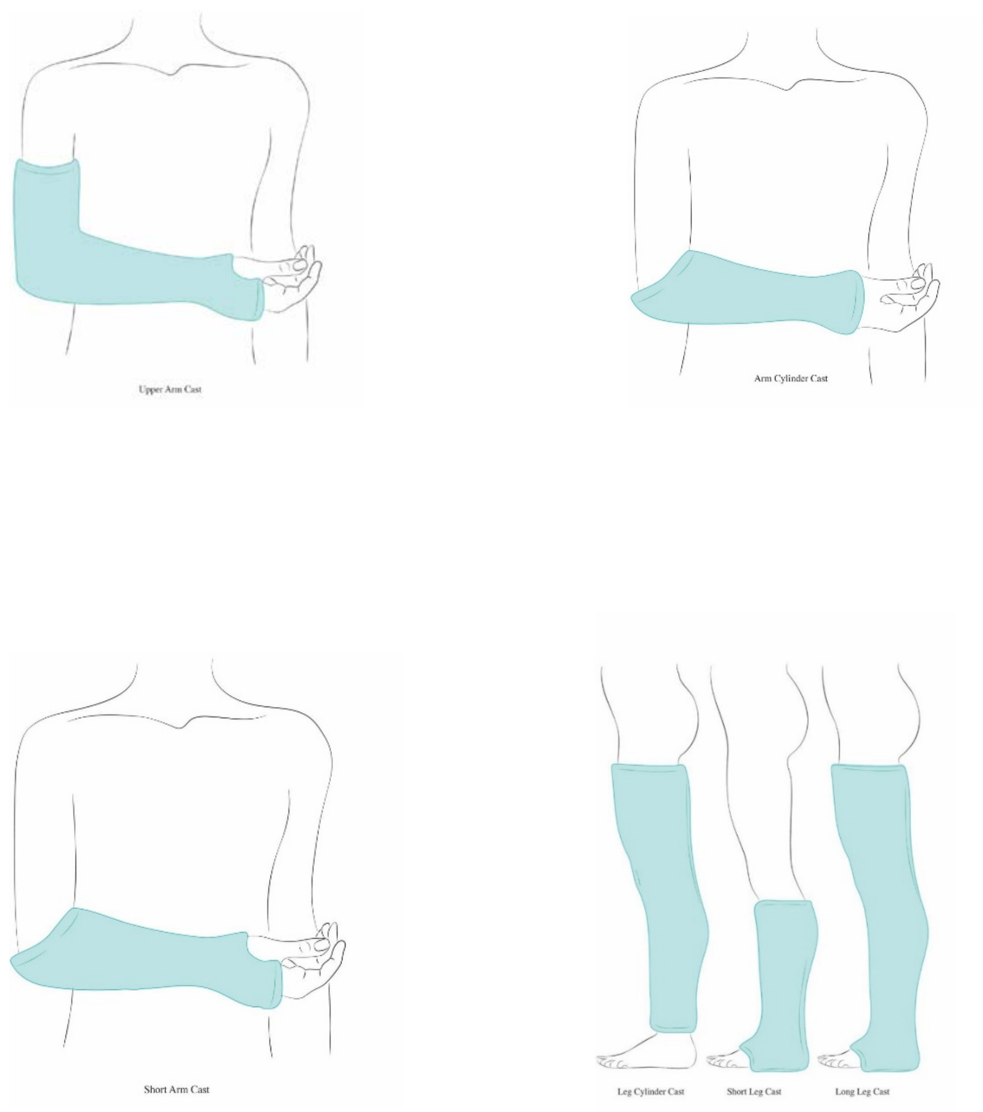


Figure 41: Types of orthopedic cast that is covered by EW cast

4-8-Process user testing

Figure 42: User testing

The sheets design for cylinder arm cast fabricated with perforation marks to adjust size and forms according to patients arm. Eight sheets were used to reach the desired depth. After soaking the sheets in water, the cast was applied to the patient's arm. As shown in figure 42, the removal strip has been placed between the two edges. Two strips were applied to ensure the safety of the procedure (one suffices). To illustrate the security of the cast Zip ties were applied as shown in figure 43. The result of the procedure was a success.

Figure 43: Cylinder arm cast application

Figure 44: Cylinder arm cast

The removal process was intriguing and simple. After cutting the zip ties, the cast removal was as easy as pulling the strip. By removing the strip, the cast was separated throughout the overlapping edge, and the arm was unwrapped.

Figure 45: Cylinder arm cast removal process

4-8-1-Removing process experiment

4-8-2-Prototyping

Figure 46: Prototyping

Figure 47: Prototyping

4-9-Packaging and marketing

Figure 48: EW Packaging design

The EW cast has been designed to be suitable for six common cast fractures. The package of each cast consists of three different sizes of small, medium, and large.

On the package, the description identifies the size and the area that EW cast will cover. Other information such as shape, thickness, application, and removal procedure is also enclosed. The medical package is adequately sealed and sterilized from the outer substance such as moisture, air, and bacteria, etc.

4-10-Target market

Figure 49: EW cast target market

The EW orthopedic cast has a potential market for every individual with fractures in range of newborn to +65, which covers the common fracture areas. Distal Humerus/ patella fracture, Tibia and Fibula fracture, Tibia fracture, Calcaneus/talus fracture, Fibula fracture, Ankle fracture, Colles' fracture, Smith's fractures, All Radius/Ulna fractures, Distal Humerus/Humeral, Olecranon/Epicondyle fracture, are the fracture types that EW cast can cover. Medical professionals both in private orthopedic clinics, hospitals, and other Medical care's facilities are the potential buyers of the cast. Also, EW Cast could be a niche in pet care market. As it was mentioned in this article, 6.3 million individuals go through a casting procedure in the United

States each year, and EW orthopedic cast can cover 3.3 million of the fractures (53%). (Figure 50)

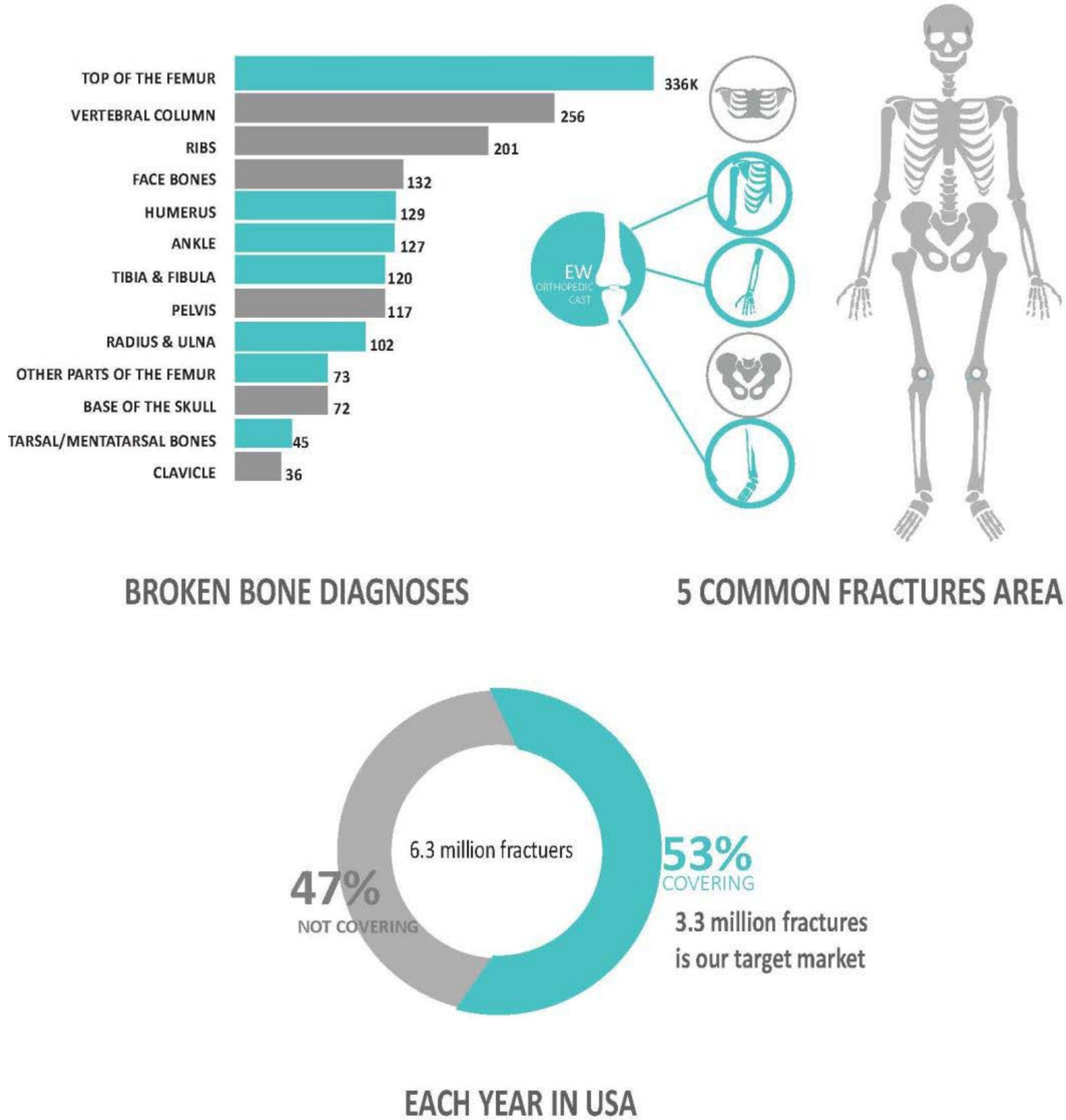


Figure 50: Areas covered by EW cast (green areas)

Figure 51: RIT gallery show

Conclusion

Although there are issues affecting the healthcare industry and its professionals, there is also many improvements being made. The potential damage that threatens medical field is scattered throughout the industry. Nonetheless, everyone must address and improve the issues. The harm assortment within healthcare industry could have an indirect or direct repercussion in which could involve emotional or physical consequences. The psychological harm could contain a series of anxiety for both patient and physician. Although the emotional harm is less well uncovered than a direct harm, yet it plays a crucial role in medical industry's lawsuits. On the other hand, the direct harm also known as physical harm and its magnitude of lawsuits are the primary expenditure factor within the industry.

The orthopedic field is one of the leading sectors involved in many lawsuits caused by operating power equipment during the removal application of an orthopedic cast. The primary purpose of this project is to eliminate a fragment of harms within the orthopedic field. The EW cast is an enhancement of the existing application and removal process in which it can eliminate abrasive, thermal injuries for patients and iatrogenic injuries for medical professionals. Utilization of the EW cast amongst the clinics and hospitals will reduce a vast majority of the harm caused by power tools in the orthopedic field.

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